D366 PM1.03
Equip Services

Multimeter
PM2618X/01/11/31
PM2718X/01/11

03M02A8

Service Manual

4822 872 35305
860526

I&E
Industrial & Electro-acoustic Systems Division

PHILIPS
Industrial &
Electro-acoustic Systems

PHILIPS

Multimeter
PM2618X/01/11/31
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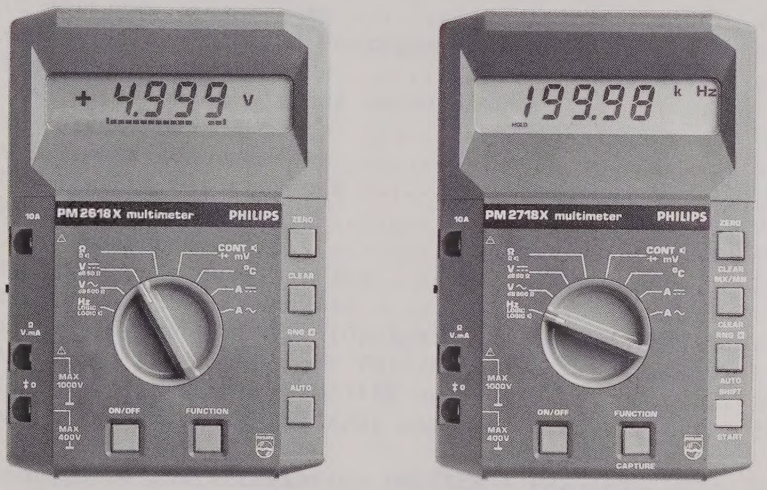

ST5052

WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock do not perform any servicing other than that specified in the Operating instructions unless you are fully qualified to do so.

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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: The design of this instrument is subject to continuous development and inprovement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

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1. SAFETY INSTRUCTIONS

Read these pages carefully before installation and use of the instrument.

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.1 GENERAL CLAUSES

1.1.1 WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and accessible terminals which can be dangerous to life.

1.1.2 The instrument shall be disconnected from all voltage sources before it is opened.

1.1.3 Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.1.4 Components that are important for the safety of the instrument may only be renewed by components obtained through your local Philips organisation.

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2. CHARACTERISTICS PM2618X/01/11/31 PM2718X/01/11

2.1 Performance Characteristics

-Properties expressed in numerical values with stated tolerance are quaranteed by PHILIPS organisation in your country. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.

2.2 GENERAL

		PM2718X	PM2618X
Manufacturer	Nederlandse Philips bedrijven B.V. I&E		
Typenumber	PM2718X/01/11 - PM2618X/01/11		
Designation	Digital multimeter		
Measurement	V⎓, V~, A⎓, A~, Ohm, ⧫, CONT ⧫, °C, ZERO SET, dB (50 Ohm), Hz, Logic, Audible tone, Bargraph	MAX/MIN CAPTURE	

2.3 MEASUREMENT PERFORMANCE

2.3.1 DC voltage measurements

Ranges	1 V, 10 V, 100 V, 1000 V		
Max. input voltage	1000 V		
Resolution	100 µV in 1 V range		
Number of representation units	11.000		
Accuracy	1 V, 10 V, 100 V range		
	± % of reading	0.05%	0.1%
	± % of range	0.02%	0.02%
	1000 V range		
	± % of reading	0.1%	0.1%
	± % of range	0.02%	0.02%
Temperature coefficient	± 0,015%/°C		
Input impedance	1 V, 10 V range, 10 MOhm ±1% 100 V, 1000 V range, 9.1 MOhm ±1%		
Offset current at input	< 20 pA		
Series mode rejection ratio (SMRR)	for AC signals of 50/60 Hz: 1 V, 10 V 60 dB 100 V, 1000 V 40 dB		

		PM2718X	PM2618X
Common mode rejection ratio (CMRR)	100 dB for DC signals 80 dB for AC signals, 50/60 Hz		
Max. common mode voltage	400 V		
Response time	< 1 s without ranging < 1.5 s with ranging		
Zeroing	Automatic		
Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR
High voltage sign	High voltage sign (ϟ)if Vin > 110 in 1000V range		
Maximum voltage	HI and LO 1000 Vrms HI and EARTH 1000 Vrms LO and EARTH 400 Vrms		
Max. VHz product of input signal	10^7		

2.3.2 dB measurements of DC voltages

Range	-47 ... +53.8 dB		
Max. input voltage	110 V		
0 dB absolute reference	1 mW in 50 Ohm (0.2236 V)		
Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR
Resolution	0.1 dB for Signals > 10 mV (-27 dB) 1 dB for signals < 10 mV Underload (UL) for signals < 1 mV Overload (OL) for signals > 110 V		
Number of representation units	999 for signals > 10 mV 99 for signals < 10 mV		
Accuracy signals > 10 mV (-27 dB) < 10 mV	± 0.1 dB ± 1 dB		
Temperature coefficient	0.0015 dB/°C		
Input imdedance	For signals < 10 V (+33 dB) 10 MOhm ±1% For signals > 10 V 9.1 MOhm ±1%		

			PM2718X	PM2618X
	Offset current at input	< 20 pA		
	Series mode rejection ratio (SMRR)	For AC signals of 50/60 Hz 1 V, 10 V: 60 dB, 100 V, 1000 V: 40 dB		
2.3.3	AC voltages measurement			
	Ranges	1 V, 10 V, 100 V, 1000 V.		
	Max. input voltage	1000 V		
	Resolution	100 µV in 1 V range Measured value less than 20 digits is displayed as zero		
	Number of representation units	11.000		
	Accuracy (between 3% and 100% of range)	40 Hz - 3 kHz % of reading	0.3%	0.5%
		% of range	0.1%	0.1%
		3 kHz - 30 kHz % of reading	0.1%/kHz	0.17%/kHz
		% of range	0.03%/kHz	0.03%/kHz
		30 kHz - 100 kHz % of reading	0.1%/kHz	0.03%/kHz
		% of range	0.03%/kHz	0.03%/kHz
	Temperature coefficient	0.03/°C		
	Input impedance	1 V, 10 V range 2.2 MOhm ±1% 100 V, 1000 V range 2 MOhm ±1%		
	Common mode rejection ratio (CMRR)	100 dB for DC signals 80 dB for AC signals 50/60 Hz		
	Frequency range		40 Hz - 100kHz	40 Hz - 30 kHz
	AC detector	True RMS convertor, AC coupled		
	Crest factor	2 at range end, indication (↑) if crest factor overload		
	Respond time	< 1s without ranging < 2s with ranging		
	Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR

		PM2718X	PM2618X
High voltage sign	High voltage sign (↯) if Vx > 110 V in 1000 V range		
Max. AC voltage	HI and LO 1000 Vrms HI and EARTH 1000 Vrms LO and EARTH 400 Vrms		
Max. DC voltage	400 V		
Max. VHz product of input signal	10^7		

2.3.4 dB measurements of AC voltages

Range	-51 ... +43.0 dB		
Max. input voltage	110 V		
0 dB absolute reference	1 mW in 600 (0.7746 V)		
Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR
Resolution	0.1dB for signals > 10 mV(-37.7dB) 1 dB for signals < 10 mV Underload (UL) for signals < 2 mV (-51dB) Overload (OL) for signals > 110 V		
Number of representation units	999 for signals > 10 mV 99 for signals < 10 mV		
Accuracy signals -20 ...+43.1dB	40 Hz ... 10 kHz	±0.2dB	±0.3dB
	10 kHz ... 30 kHz	±0.5dB	±1 dB
	30 kHz ... 100 kHz	±1 dB	±1 dB
-37.7...-20 dB	40 Hz ... 10 kHz	±1 dB	±1 dB
	10 kHz ... 30 kHz	±3 dB	±3 dB
	30 kHz ... 100 kHz	±3 dB	±3 dB
-51 ...-37.7dB	40 Hz ... 10 kHz	±3 dB	±3 dB
	10 kHz ... 30 kHz	±6 dB	±6 dB
	30 kHz ... 100 kHz	±6 dB	±6 dB
Temperature coefficient	0.003 dB/°C		
Input impedance	For signals < +22.2 dB 2.2 MOhm ±1% For signals > +22.2 dB 2 MOhm ±1%		

		PM2718X	PM2618X
Common mode rejection ratio (CMRR)	100 dB for DC signals 80 dB for AC signals 50/60 Hz		
Frequency range		40 Hz - 100 kHz	40 Hz - 30 kHz
AC detector	True RMS convertor, AC coupled		
Crest factor	2 at range end, indication (↑) by crestfactor overload.		
Response time	< 2 s		
Maximum voltage	HI and LO 1000 Vrms HI and EARTH 1000 Vrms LO and EARTH 400 Vrms		
Max. DC voltage	400 V		
Max. VHz product of input signal	10^7		

2.3.5 Resistance measurements

Ranges	1 kOhm, 10 kOhm, 100 kOhm, 1 MOhm, 10 MOhm, 100 MOhm (manual only)		
Resolution	100 MOhm in 1 kOhm range		
Number of representation units	11000 for all ranges except 100 MOhm 1100 for 100 MOhm range		
Accuracy	1 kOhm, 10 kOhm, 100 kOhm,		
	1 MOhm % of reading	0.15%	0.3%
	% of range	0.05%	0.1%
	10 MOhm % of reading	0.3%	0.5%
	% of range	0.1%	0.1%
	100 MOhm % of reading	5%	5%
	% of range	3%	3%
Temperature coefficient	1 kOhm, 10 kOhm, 100 kOhm, 1 MOhm ranges: ±0.02%/°C 10 MOhm range: ±0.05%/°C 100 MOhm range: ±1%/°C		
Measuring current	1 mA, 100 µA, 10 µA, 1 µA, 100 nA, 10 nA		
Max. voltage at open input	3 V		
Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR

		PM2718X	PM2618X
Audible tone	ON/OFF with pushbutton FUNCTION LOW TONE if display <1000 ±4 digits HIGH TONE if display <100 ±4 digits		
Polarity of input terminals	- on HI; + on LO		
Response time	< 1 s without ranging (except 100 MOhm range) < 3 s with ranging 100 MOhm range (manual only) < 10 s		
Protected up to	250 Vrms		
Maximum voltage	HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms		

2.3.6 Continuity check & diode measurements

Function selection	Continuity/diode with button FUNCTION (default function: continuity check)		
Driving current	1 mA		
Range	Diode function 1 V Continuity check 1 kOhm		
Resolution	Diode function 100 µV Continuity check 100 MOhm		
Number of representation units	11.000		
Audible tone by continuity check	Low tone if display <1000 ±10 digits High tone if display <100 ±10 digits		
Relative reference setting	ON/RECALL with pushbutton ZERO OFF with pushbutton	SHIFT-ZERO	CLEAR
Response time continuity check	< 0.2 s		
Protected up to	250 Vrms		
Maximum voltage	HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms		

			PM2718X	PM2618X
2.3.7	DC current measurements			
	Ranges	20 mA, 200 mA, 2 A, 20 A		
	Max. input current in 20 A range	10 A continue, 20 A for 20 s		
	Resolution	100 µA in 20 mA range		
	Number of representation units	2200		
	Accuracy	± (0,5% of reading + 0.1% of range)		
	Temperature coefficient	± 0,05%/°C		
	Voltage drop over shunt	20 mA, 2 A range: < 25 mV 200 mA, 20 A range: < 250 mV		
	Response time	< 1 s		
	Protected up to	250 Vrms range 20 mA, 200 mA range 2 A, 20 A not protected		
	Max. common mode voltage	400 V		
	Relative reference setting	ON/RECALL: with pushbutton ZERO OFF with pushbutton	SHIFT-ZERO	CLEAR
	Maximum voltage	HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms		

		PM2718X	PM2618X
2.3.8	**AC current measurements**		
	Ranges	20 mA, 200 mA, 2 A, 20 A	
	Max. input current in 20 A range	10 A continue, 20 A for 20 s	
	Resolution	100 µA in 20 mA range Measured value less than 20 digits is displayed as zero	
	Number of representation units	2200	
	Accuracy (valid between 3% and 100% of range)	± (0,8% of reading + 0.1% of range) at 50 Hz input signal	
	Temperature coefficient	± 0,05%/°C	
	Voltage drop over shunt	20 mA, 2 A range: < 25 mV 200 mA, 20 A range: < 250 mV	
	Frequency range	40 Hz - 1 kHz	
	AC detector	True RMS converter, AC coupled	
	Crest factor	9 at range end. Indication (↑) if crest factor overload	
	Response time	< 2s	
	Protected up to	250 Vrms range 20 mA, 200 mA range 2 A, 20 A not protected	
	Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR
	Maximum voltage	HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms	

			PM2718X	PM2618X
2.3.9	Temperature measurements (with Pt100-Ω probe PM9249)			
	Transducer type	Pt 100		
	Range	-60 .. +200°C		
	Resolution	0,1°C		
	Number of representation units	11000		
	Accuracy (incl. probe)(PM2618, PM2718, PM9249)	-20 ... +100°C ± 1°C -60 ... -20°C ±1 to -2.5°C +100 ... +200°C +1 to -5°C		
	Permissable voltage at probe tip	60 VDC, 30 VAC VAC		
	Relative reference settting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR
2.3.10	Frequency measurements			
	Ranges	19.999 kHz, 199.99 kHz		
	Resolution	1 Hz		
	Number of representation units	20.000		
	Accuracy	± 0,1% of reading		
	Gate time	1 s		
	Conversion time	1 conv/s		
	Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton	SHIFT-ZERO	CLEAR
	Input sensitivity	1 V peak-peak (10 Hz - 200 kHz)		
	Input impedance	2 MOhm // 33 pF		
	Coupling	AC		
	Maximum voltage	HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms		

		PM2718X	PM2618X
2.3.11	**Logic measurements**		
	Displayed logic states: Open leas Logic "0" Bad level Logic "1" Positive pulse Symmetric pulse Negative pulse		
	Threshold levels: NO PULSE: Open : Vx < -0.25 V Logic "0" : 0.25 V < Vx < 0.25 Vcc Bad level : 0.25 Vcc < Vx < 0.75 Vcc Logic "1" : 0.75 Vcc < Vx PULSE: Pos. pulse : V average < 0.25 Vcc Symm. pulse : 0.25 Vcc < V average < 0.75 Vcc Neg. pulse : 0.75 Vcc < V average		
	Treshold level resolution: ± 50 mV		
	Logic supply reference Vcc: 3.2 V default (0.8V, 2.4V TTL level) SET/RECALL with pushbutton ZERO DEFAULT with pushbutton	SHIFT-ZERO	CLEAR
	Logic supply range: 0-100 V		
	Minimum pulse duration: 100 ns duty cycle > 20% 200 ns duty cycle < 20%		
	Max. frequency (symm.): 10 MHz duty cycle ± 50%		
	Audible tone: ON/OFF with pushbutton FUNCTION Low tone for Logic "0" High tone for Logic "1" Intermittend high tone for Pulse		
	Max. voltage: HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms		

		PM2718X	PM2618X
2.3.12	Relative reference setting		
	Applicable in functions: All functions (special use in LOGIC: Vcc setting)		
	Set reference setting: By pressing pushbutton ZERO. Last displayed value is entered as relative reference		
	Recall reference: By pressing and holding the button ZERO		
	Clear reference: By pressing pushbuttons	SHIFT-ZERO	CLEAR
	Automatic: by switching to AUTO-ranging and function change		

2.3.13 Bargraph PM2618X & PM2718

Modes
- Trend indication
- Zero detector
- Continuity indication

Trend indication

Applicable in functions: All functions except: Hz, logic, Cont, °C. The gap in the indicated bar moves to the right if the measured value increases, and to the left if the value decreases.

Zero detection

Applicable in functions: All functions except Logic. This mode is always selected in combination with ZERO SET. The length and the direction of the displayed bar indicates if the measured value is above (bar to the right of the center) or below (bar to the left of the centre) the relative reference point.

Continuity indication

Applicable in function: Continuity check only. The displayed bar closes as the measured value decreases.

2.3.14 Data hold probe PM9267 (Optional) PM2618X & PM2718X

Max. input voltage	42 V
Normal data hold operation	Push "HOLD" for data hold on Display : HOLD ..... probe Hold led on probe : on Push "HOLD" for data hold off
With capture function (PM 2718X only)	"HOLD" button activates forced start (same as shift-start). Hold led on probe: no function
Bleeper led =	Visual indication if beeper is on (display < 1000 digits in Ohm and cont. check). (Stable value in capture)
Bleeper led in logic function	Open : blinking high duty cycle Logic "0": off Bad : blinking high duty cycle Logic "1": constant on Pulse : blinking low duty cycle

2.3.15 Maximum - minimum memory PM2718X ONLY

Applicable in functions	All, except logic. The function is always active. The highest displayed value is stored in the MAX-memory, the lowest displayed value in the MIN-memory.
Recall MAX	Push MAX/MIN once for the MAX memory to be displayed
Recall MIN	Push MAX/MIN twice for the MIN memory to be displayed.
Clear MAX/MIN	Push SHIFT-MAX/MIN/CLEAR Automatic: by ZERO SET and function change.

2.3.16 Capture measurements PM2718X ONLY

Applicable	All functions. The capture function displays and holds the last stable measurement value untill a new stabel value is available. Open leads are ignored.
Capture ON	Push SHIFT-CAPTURE
Capture OFF	Push SHIFT-CAPTURE Automatic: by function change
Open leads definition	Ohm-functions: value = overload Other functions: |value| < 100 digits
New value definition	|VAL(n) - VAL(n+1)| > 8 digits
Audible tone	High tone if a stable value is found
Forced start	Push SHIFT-START

2.3.17 mAS measurements PM2618X/31 ONLY

Ranges	20 mAs, 200 mAs, 2 As, 20 As
Maximum input current on 20 A socket	10 A continue, 20 A for 20 s
Resolution	10 µAs in 20 mAs range
Number of representation units	2200
Accuracy 3% ... 100%	± (1% of reading + 0.3% of range)
Temperature coefficient	± (0,06% of reading + 0,06% of range)
Drift	< 2 digits/s
Min. pulse width	0,5 ms
Max. pulse width	1 s
Voltage drop over shunt	20 mAs, 2 As range < 25 mV at 20 mA resp. 2 A 200 mAs, 20 As range < 250 mV at 200 mA resp. 20 A
Voltage drop over the input sockets	20 mAs, 2 As range < 100 mV at 20 mA resp. 2A 200 mAs, 20 As range < 1 V at 200 mA resp. 20A
Protection up to	250 Vrms ranges 20 mAs, 200 mAs Range 2 A, 20 A not protected Max. current 20 A for 20 s.
Max. common mode voltage	400 V
Zero setting integration	By switching the ERASE knob
Relative reference setting	ON/RECALL: with pushbutton ZERO OFF: with pushbutton CLEAR
Maximum voltage	HI and LO 250 Vrms HI and EARTH 400 Vrms LO and EARTH 400 Vrms

2.4 CONVERSION CHARACTERISTICS PM2718X & PM2618X

Kind of conversion	Linear
Operating principle	Delta modulation
Basic mode of operation	Repetitive triggered
Range setting	Automatic Manual by means of UP steps
Polarity setting	Automatic

2.5 VISUAL REPRESENTATION PM2718X & PM2618X

Range setting	Range up at 2200 ±4 for (m)A ranges 11000 ±4 for other ranges 20000 ±1 for Hz ranges Range down at 200 ±4 for (m)A ranges 1000 ±4 for other ranges 1900 ±1 for Hz ranges
Output value representation	LCD 100mm, reflective Additional analog representation by bargraph
Polarity representation	Automatic + and - in LCD
Function representation	With function selector and textplate
Unit representation	Automatic in LCD
Overload representation	LCD indicates OL
Underload representation (dB only)	LCD indicates UL
Decimal point representation	Automatic in LCD
Data hold	By using data hold probe PM 9267 with build in capture function (PM 2718X)
Range hold	By pushbutton RNG

2.6 OPERATING CONDITIONS IN ACCORDANCE WITH IEC 359 PM2718X & PM2618X

Climatic conditions	Group I of IEC 359 with extension of the temperature limit
Upper temperature limit	+55°C
Reference temperature	+23 ±2°C
Rated range of use	-10°C ... +55°C
Specified range	0°C ... +45°C
Relative humidity	20 ... 80% excluding condensation Max. dew point 28°C
Limit range of storage and transport	-40°C ... +70°C
Mechanical conditions	Group II
Fields and radiation	Mil. 461B (except susceptibility)
From external origin	Electric and electromagnetic fields Magnetic fields Ionizing radiation

2.7 POWER SUPPLY PM2718X & PM2618X

Batteries	4x type R14 or LR14
External supply	9V with power supply PM 9218A
Power consumption	PM2618X/PM2718X /01 < 45 mW PM2618X/PM2718X /11 < 180 mW, light on
Operation Battery operation	ON/OFF with pushbutton ON/OFF. Automatic OFF switching approx. 30 min. after last switch action or automatic range change.
External supply	ON/OFF with pushbutton ON/OFF

2.8 TIME FUNCTION ADC PM2718X & PM2618X

Conversion rate	2.5 measurements/s
Range changing time	0.1 s/range
Recovery time from overload in DC voltage ranges	< 5 s

2.9 CALIBRATION PM2718X & PM2618X

Recalibration interval	1 year Electronic calibration without opening the cabinet

2.10 ACCESSOIRES PM2718X & PM2618X

Supplied with instrument	Measuring leads PM 9266 (incl. probe) Fuses 1x 630 mAT slow blow Operating manual	
Optional	Temperature probe	PM 9249
	EHT probe	PM 9246
	Current transformer	PM 9245
	HF probe	PM 9210
	HF probe	PM 9213
	Shunt	PM 9244
	Data hold probe	PM 9267
	Interface adaptor	PM 9181
	Mains adaptor	PM 9218A

2.11 PM2718X & PM2618X MISCELLANEOUS

-Overall dimensions:
.Height : 60 mm
.Width :120 mm
.Depth :175 mm
-Maximum weight :0,6 kg

2.12 SAFETY CHARACTERISTICS PM2618X & PM2718X

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, VDE 0411 and has been supplied in a safe condition.

This manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.

2.13 ENVIRONMENTAL CHARACTERISTICS PM2718X & PM2618X

The environmental data mentioned in this manual are based on the results of the manufacturer´s checking procedures.
Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by PHILIPS, INDUSTRIAL & ELECTRO-ACOUSTICAL EQUIPMENT DIVISION, EINDHOVEN, THE NETHERLANDS.

3. CIRCUIT DESCRIPTION

3.1 INTRODUCTION

The PM2618X and PM2718X are two instruments out of the 18 series multimeters (PM2518X, PM2618X, PM2718X).
The basic mechanical parts such as housing, battery cover are the same (except text-screening).

The PM2618X and PM2718X have the following additions with respect to the PM2518X.

PM2618X:
1. Bargraph having null-mode, Trend indication and continuity check.
2. 200 kHz counter function via normal test leads.
3. 10 MHz logic probe facilities via normal test leads, indicating high, low tri-state, pulsing high, and pulsing low levels.
4. Electronic calibration.

PM2718X: As PM2618X
1. Improved DC; AC and Ohm accuracy
2. Data Hold function built-in
3. Min/Max measurement

3.2 VERSION OVERVIEW

Functions	PM2618X /01	/11	/31	PM2718X /01	/11
Hz Logic Logic◧	X	X	X	X	X
V~ dB600	X	X	X	X	X
V ⎓ dB50	X	X	X	X	X
Ω	X	X	X	X	X
CONT mV	X	X	X	X	X
°C	X	X	X	X	X
A⎓	X	X	X	X	X
A~	X	X	X	X	X
(CLEAR)	X	X	X	X	X
RNG* (AUTO/MAN)	X	X	X	X	X
MX/MN (CLEAR)				X	X
CAPTURE (START)				X	X
BACKLITE		X	X		
mAS			X		

Remarks:

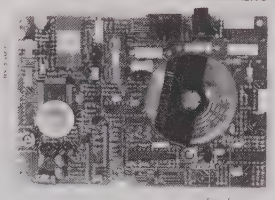
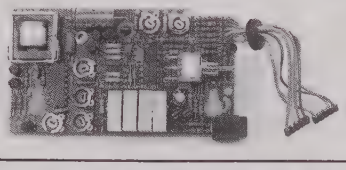
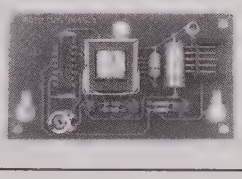
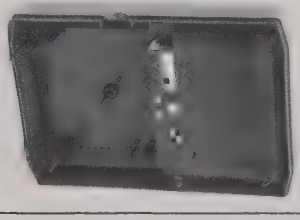
letters are main functions with a relation to hardware.

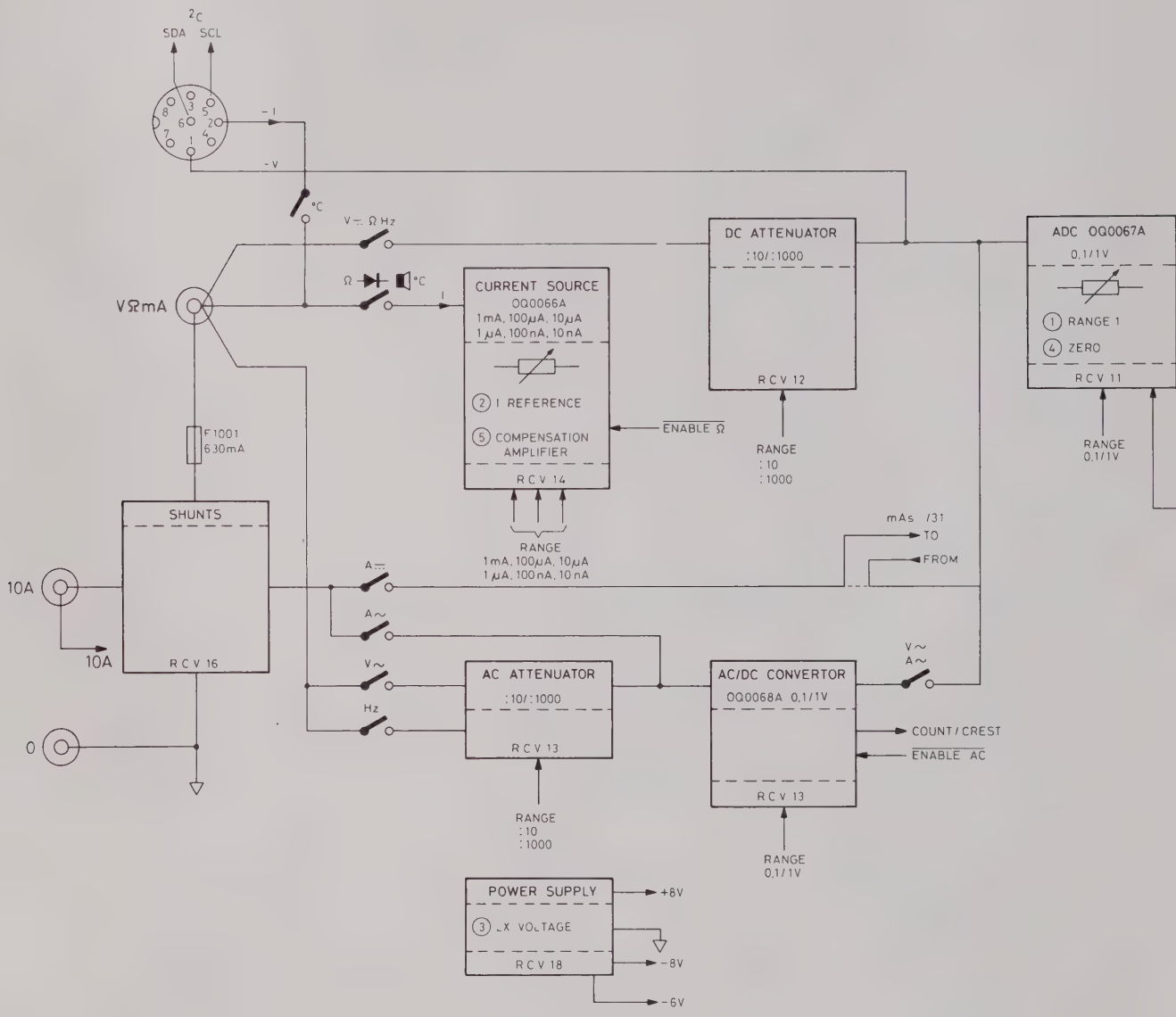
Normal letters are sub-functions derived from the main function that are calculated or converted by the software.

In all versions the same 64 pins flat pack microprocessor with internal ROM is used. The difference in program between PM2618 and PM2718 is obtained by selecting other part of the program. The selection is made with the resistor R1726 or R1723.

The accuracy improvement between PM2618 and PM2718 is obtained by a more accurate adjusting procedure and the selection of the PM2718 software.

3.3 PHYSICAL BUILT-UP

MECHANICAL	PM2618X			PM2718X	
	/01	/11	/31	/01	/11
PC BOARD N1 	X	X	X	X	X
LX	X			X	
LX (TRANSFLECTIVE)		X	X		X
PC BOARD N2 /31 			X		
PC BOARD N2 /11 		X			
TOPCOVER	X	X	X		
TOPCOVER				X	X
BOTTOMCOVER 	X	X	X	X	X


I²C
SDA SCL
- I
- V
°C
V⎓ Ω Hz
Ω
°C
I
VΩmA
CURRENT SOURCE
OQ0066A
1mA, 100µA, 10µA
1µA, 100nA, 10nA
② I REFERENCE
⑤ COMPENSATION AMPLIFIER
RCV 14
ENABLE Ω
DC ATTENUATOR
:10/:1000
RCV 12
RANGE
:10
:1000
ADC OQ0067A
0,1/1V
① RANGE 1
④ ZERO
RCV 11
RANGE
0,1/1V
F1001
630mA
SHUNTS
RCV 16
10A
10A
0
RANGE
1mA, 100µA, 10µA
1µA, 100nA, 10nA
A⎓
A~
V~
Hz
mAs /3↑
TO
FROM
AC ATTENUATOR
:10/:1000
RCV 13
RANGE
:10
:1000
AC/DC CONVERTOR
OQ0068A 0,1/1V
RCV 13
V~
A~
COUNT/CREST
ENABLE AC
RANGE
0,1/1V
POWER SUPPLY
③ -X VOLTAGE
RCV 18
+8V
-8V
-6V

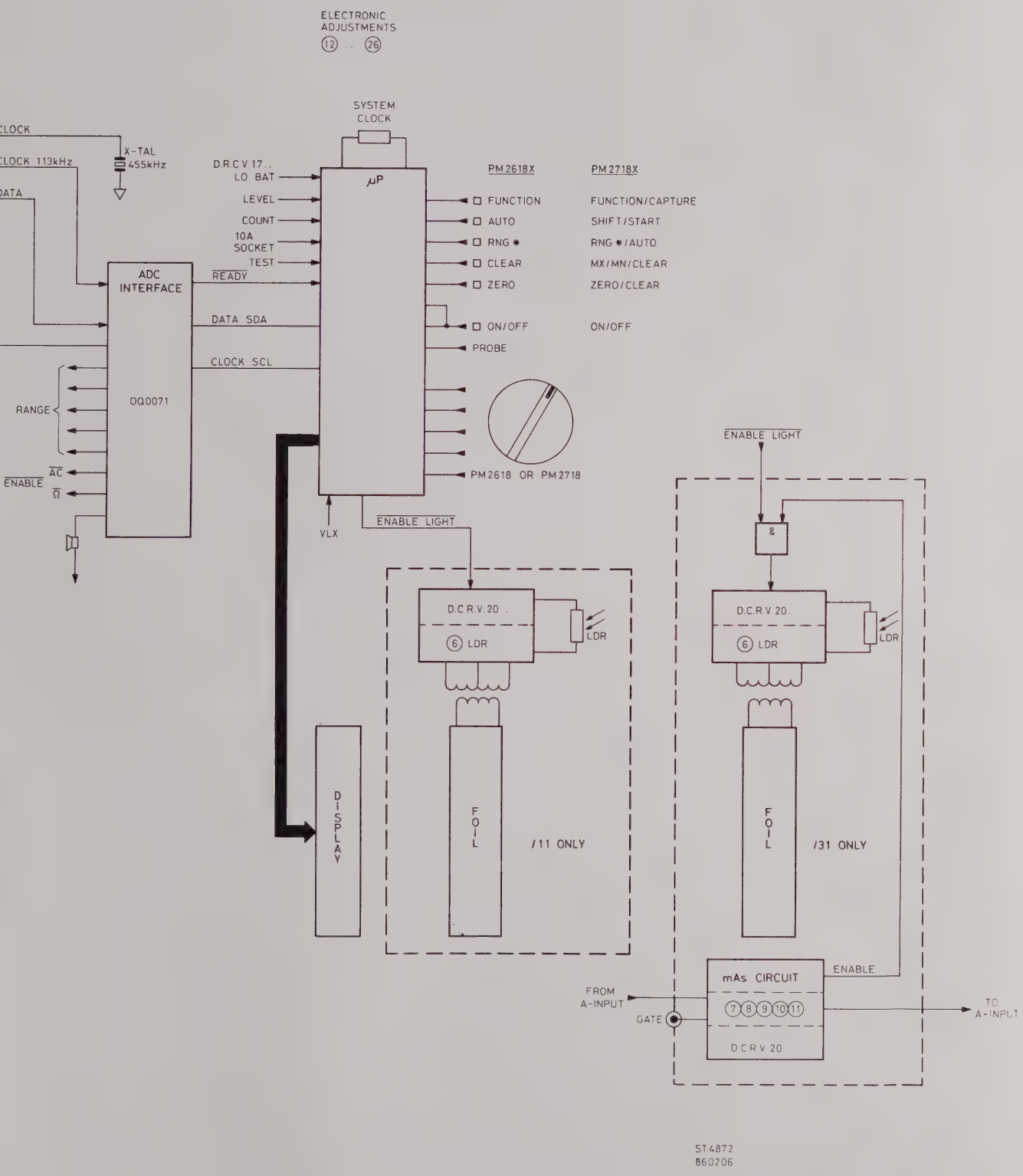


Figure 3.1 Blockdiagram PM2618X/01/11/31 and PM2718X/01/11

3.4 EXPLANATION OF THE BLOCKDIAGRAM

The instruments can be subdivided into three parts viz: ANALOG, ADC, DIGITAL.

3.4.1 Analog part

The analog part consists of special made integrated circuits and their input circuitry.
viz: -For DC voltage /dB50Ω only a DC-attenuator :10 :1000

-For AC voltage /dB600Ω an AC-attenuator :10 :1000 and a AC/DC convertor IC 0Q0068A. The AC/DC convertor has a progammable input sensitivity of 0.1 V. The converter can be enabled with signal $\overline{\text{ENAC}}$.

-For DC currents two shunts. One for the 20 mA and 200 mA range, and one for the 2 A and 20 A range. The 2 A/20 A range have a combined separate input.

-For AC currents two shunts as for dc currents and a AC/DC convertor as for AC voltages.

-For resistance/diodes/temperatures/continuity/Ω◀ a programmable current source 0Q0066A with the different currents for the ranges and the DC-attenuator. The current source can be enabled with signal $\overline{\text{ENΩ}}$

-For Hz a AC/DC convertor as for AC voltages, however the convertor is set to count mode.

-The dB function is related to the corresponding main functions VDC and VAC. Under software control the measured voltages are calculated to dB values.

-The functions logic and logic◀ are related to the Hz function. Under software control the input signals are converted into logic symbols.

-The ◀ functions limits are determined by the software.

-The Max/Min mode is continuous on (software control). On depress of the MX/MN key the value is displayed.

-The Capture mode can be switched on in every function. The limits are determined by the software.

3.4.2 ADC (Analog to Digital Convertor)

The ADC consists of one IC 0Q0067A according the Delta Modulation principle. It has a dual input, the possibility for AUTO/ZERO compensation and a programmable input sensitivity of 0.1 V and 1 V.

3.4.3 Digital parts

Consists of:

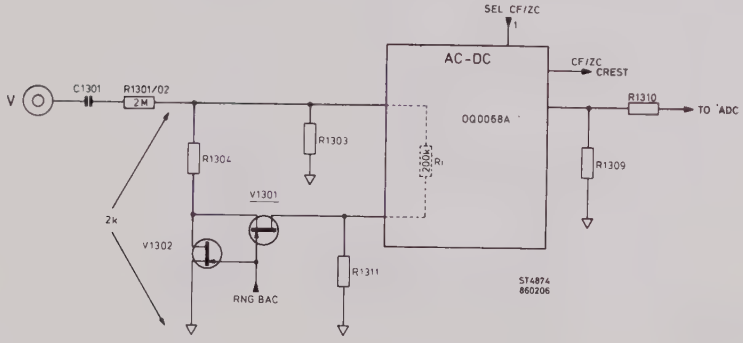
- Special up with built-in ROM upD7503-flat pack, 64 pins
  Inputs: Mode switches, Function selector, 10 A socket, Crest factor/ Count, I^2C Bus, Level, PM2618X/PM2718X, $\overline{INT}$, TEST, PON, EP.
  Outputs: I^2C BUS, LX display and enable illumination for /11 only.

- ADC interface 0Q0071. This circuit receives data via the I^2C-BUS from the up and will run independently of the up. When finished it will produce signal ready for the up.
  The interface receives its clock indirectly from the up clock (:4). It supplies range switching information to the analog section, enables signals for the current source and the AC/DC convertor. It takes care of conversion of the ADC data signal into I^2C level data for the up.

3.5 PRINCIPLE OF OPERATION

3.5.1 DC voltage attenuator

-Ri ADC is ≃ 900 kΩ
-Attenuation 10 or 1000
-R1110 for elimination of Ri of FET´s

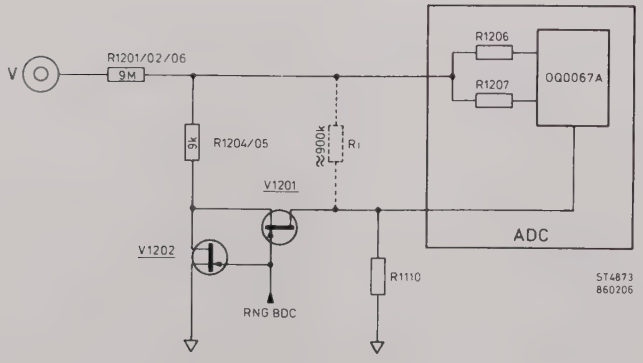


V ⎓	BDC	ATTN	ADC
1000 mV	0	10	0.1 V
10 V	0	10	1 V
100 V	1	1000	0.1 V
1000 V	1	1000	1 V

Figure 3.2 DC voltage attenuator

3.5.2 AC voltage attenuator

-Ri AC/DC convertor is ≃ 200 kΩ
-Attenuation 10 or 1000



V ~	BAC	ATTN	AC/DC	ADC
1000 mV	0	10	0.1 V	1 V
10 V	10	10	1 V	1 V
100 V	1	1000	0.1 V	1 V
1000 V	1	1000	1 V	1 V

Figure 3.3 AC voltage attenuator

3.5.3 AC/DC shunts

Range 20 mA 200 mA 1 Ω shunt
Range 2 A 20 A 0.01 Ω shunt

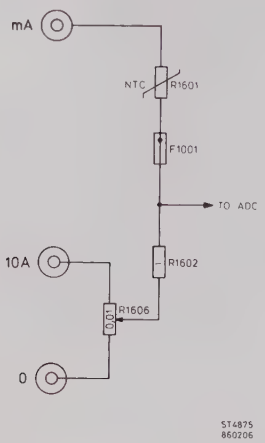


Figure 3.4 AC/DC shunts

3.5.4 Current source

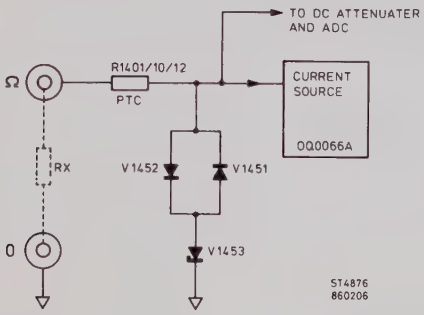


Figure 3.5 Current source

Compensation of ADC leakage current (I ADC)

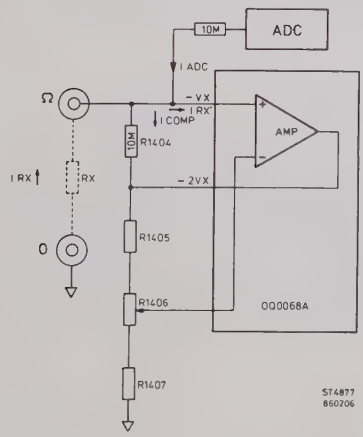


Figure 3.6 I ADC compensation

Compensation of safety diode leadage current. (I leak)

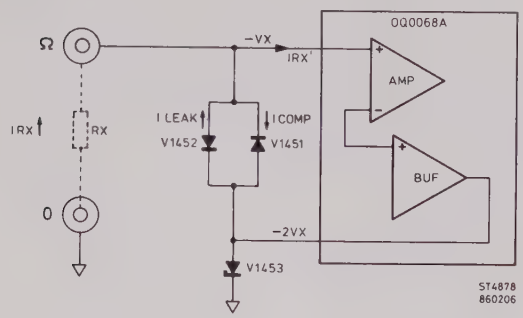


Figure 3.7 I diode compensation

3.5.5 Power supply

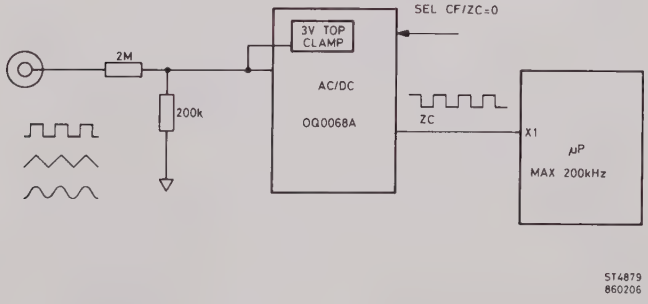
- 9 V extern is decreased to 6 V by zenerdiode V1851 and transistor V1804 and supplied to the switched power supply resulting in + and -8 V.

- Signal $\overline{EP}$ (enable power) switches of the power supply. EP is generated by the up after 30 minutes if no change of range or function has been made. From signal $\overline{EP}$ signal ENPRW is derived that enables the mode switches and function selector (data to up).

- Signal $\overline{EXT\ PWR}$ (external power) indicates the use of an external supply to the up. Signal $\overline{EP}$ stays true.

- Signal $\overline{LO\ BAT}$ indicates low battery voltage (3.75 V ± 0,1 V) to the up. The result is LOW BATT on the display.

3.5.6 Frequency measurements (Hz)



3.5.7 Logic

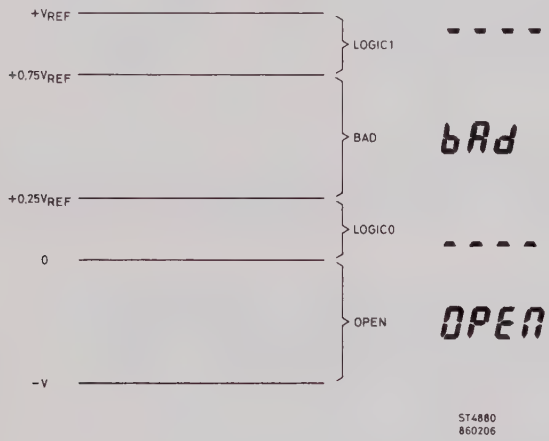
3.5.7.1 General

Subdivision: 1. Logic level detection ⟶ for DC signals
2. Duty cycle detection ⟶ for pulses

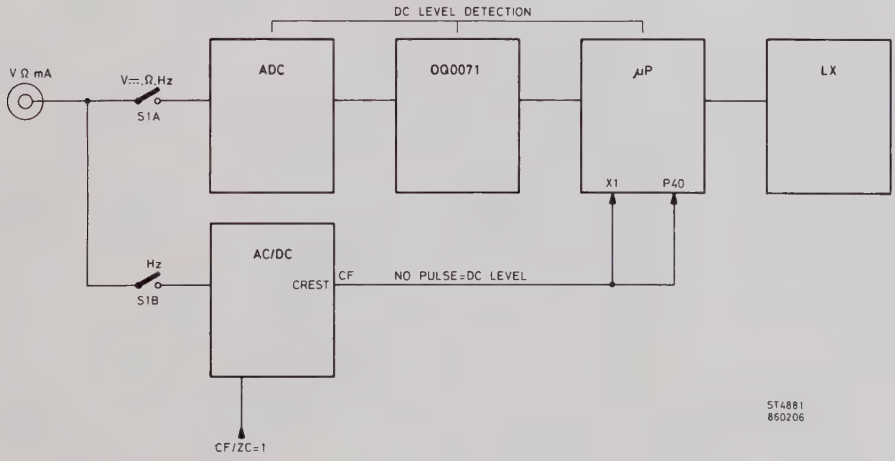
Note: Both functions are combined.

3.5.7.2 Logic level detection

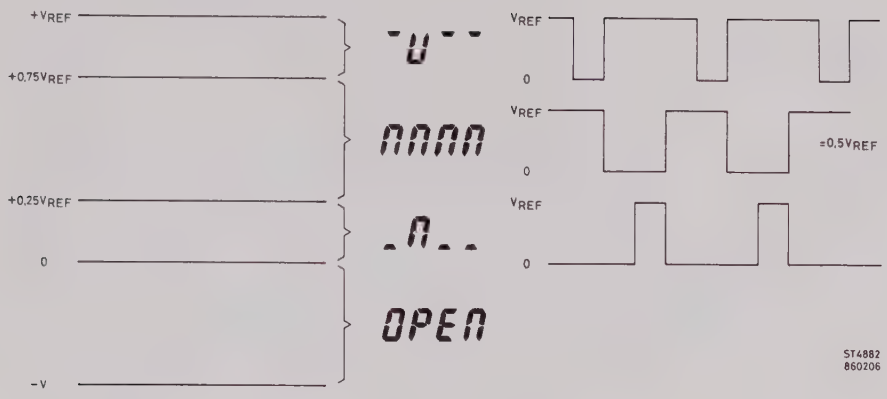
Standard levels in the microcomputer are

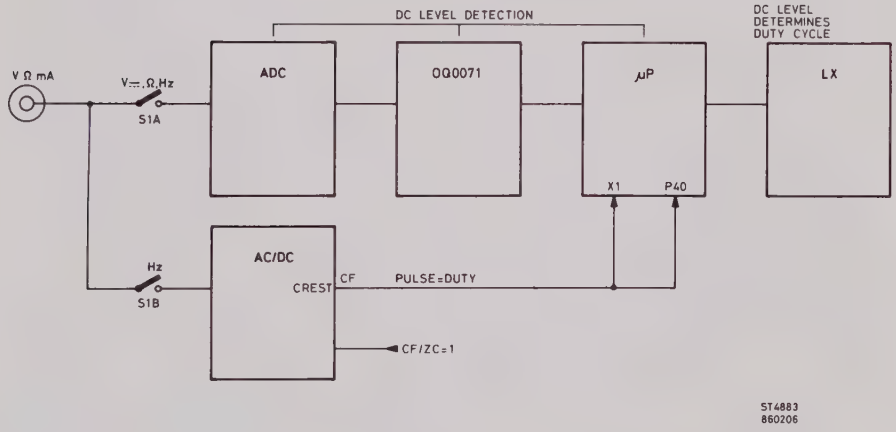


Remark: The default Vref level is + 3.2 V (TTL). With ZEROSET another Vref can be memorized.

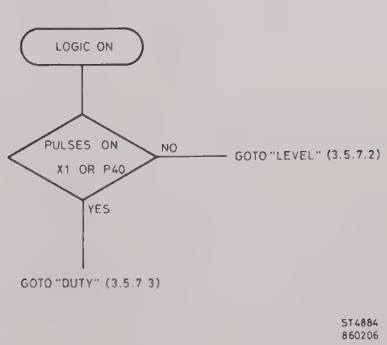


3.5.7.3 Duty cycle detection

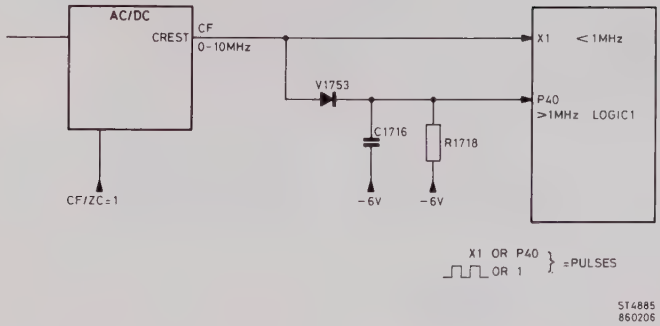




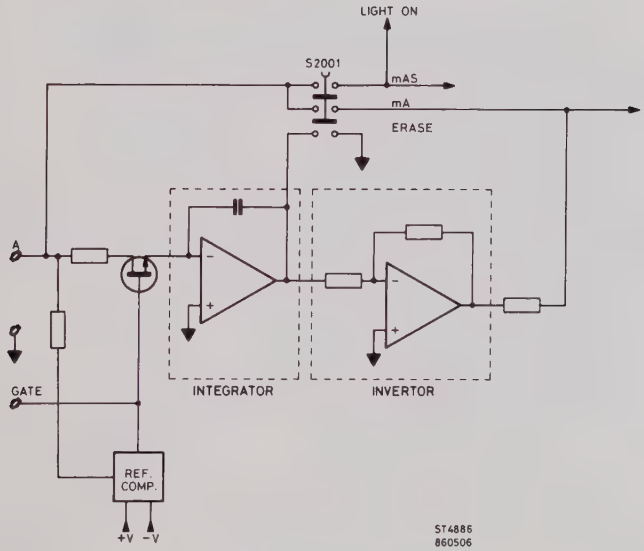
3.5.7.4 Flow chart logic



3.5.7.5 Pulse µp Detection via X1/P40



3.5.8 mAS PM2618X/31



The mAs section calculates and displays the product of current and time.
The mAs measurements are used for X-ray equipment.
A combination of integrator and invertor (A2001 A, D) is used for this purpose.
The following states can be distinguished:

- No input current:
  To reduce the offset influence of the integrator V2014 is used to switch off the input stage from the integrator. It is controlled by two comparators (A2001 B, C). Only the bias current causes offset now.
  When an inputcurrent is present, one of the comparator outputs (depending on the polarity of the inputsignal) switches from +8 Volt to -8 Volt. This "closes" V2014, and the inputstage is connected. Now the mAs measurement is started.
  To start a new measurement the capacitor of the integrator can be discharged with the switch "ERASE".

- Negative current, e.g. 200 mA
  - The output of the comparator B "closes" V2014
  - The output of the integrator increases to a positive voltage (to ≈ +4,5 V)
  - The output of the invertor decreases to a negative voltage and is attenuated (to -200 mV)

- Positive current, e.g. 200 mA
  - The output of comparator C "closes" V2014
  - The output of the integrator decreases to negative voltage (to ≈ -4,5 V)
  - The output of the invertor increases to a positive voltage and is attenuated (to +200 mV)

  The outputvoltages of the integrator and invertor are:

Range (Full scale)	Integrator output	invertor output
20 mAs	0,45 V	20 mV
200 mAs	4,5 V	200 mV
2 As	0,45 V	20 mV
20 As	4,5 V	200 mV

  The invertor output is the ADC input.

  Adjusting points for offsets are:
  R2016 integrator
  R2019 } invertor
  R2024 }
  R2029 comparator B
  R2030 comparator C

- Normal current measurements
  S2001 in position "mA".
  V2020 opens V2015, so the capacitor of the integrator cannot be charged, otherwise the read-out can be influenced.

The backlight (in a dark environment) is on for about 2 minutes for normal current measurements (PM2618X/11 and PM2718X/11) and it is on the whole time for mAs measurements (PM2618X/31).

3.6 SPECIFICATION OF SPECIAL IC´S

3.6.1 µPD 7503

4-BIT SINGLE CHIP MICROCOMPUTER

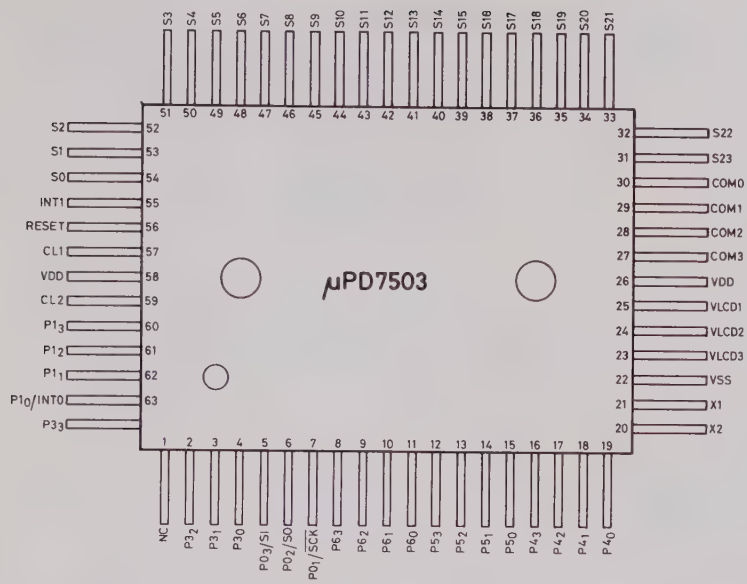
DESCRIPTION

The µPD7503 is a µCOM-75 4-bit single chip microcomputer with a 4096x8 ROM, a 224x4 RAM, a programmable 8-bit timer/event counter, and 4 vectored, prioritized interrupts. It is also capable of directly driving a 24-segment, 3 or 4-backplane multiplexed Liquid Crystal Display (LCD). The µPD7503 is manufactured with a low-powerconsumption CMOS process, allowing use of a single power supply between 2.5 and 6.0 V, and providing programmable power-down capability. It has 23 I/O lines, organized in one 3-bit parallel port, five 4-bit parallel ports, and one 8-bit serial port. The µPD7503 executes 92 instructions of the µCOM-75 instruction set, and it is available in a 64-pin plastic flat package.

FEATURES

- 4096x8 bit ROM
- 224x4 bit RAM
- 10 µs Instruction Cycle Time (typ.)
- 92 Powerful Instructions
  - Table Look-up Capability with LHLT and LAMTL instructions
  - Subroutine Address Table look up with CALT Instructions
- RAM Stack
- 4 General Purpose 4-bit Registers (D, E, H and L)
- Extensive I/O Capability
  - One 3-bit Input Port
  - One 4-bit Input Port
  - One 4-bit Output Port
  - Three 4-bit I/O Ports, of which two are 8-bit Byte Accessible
  - One 8-bit Serial I/O Port
- Programmable LCD Controller
  - 24 Segment Outputs and 4-Backplane Outputs
  - Can Directly Drive 3- or 4-Backplane Multiplexed LCDs
  - Automatic Synchronization of Segment and Backplane Signals, Transparent to Program Execution
- Programmable 8-bit Timer/Event Counter with Crystal Clock Generator
- Vectored, Prioritized Interrupts
  - 2 External
  - 2 Internal (Timer and Serial I/O)
- Single Power Supply, Variable from 2.5 V to 6.0 V
- Programmable Power-Down Operation with HALT and STOP Instructions
- Built-In System Clock Generator
- Built-In Reset Circuitry
- CMOS Technology
- 64-Pin Plastic Flat Package

PIN CONFIGURATION



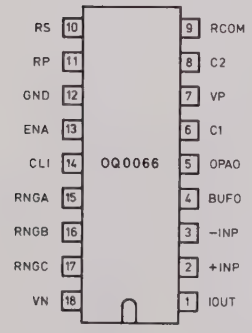
S0 - S23	LCD SEGMENT OUTPUTS
COM0 - COM3	LCD BACKPLANE OUTPUTS
$P0_1$/ SCK	INPUT PORT 0_1 / SERIAL CLOCK
$P0_2$ / SO	INPUT PORT 0_2 / SERIAL OUTPUT
$P0_3$ / SI	INPUT PORT 0_3 / SERIAL INPUT
$P0_1$ / INT0	INPUT PORT 1_0 / INTERRUPT 0
$P1_0$ / $P1_3$	INPUT PORT 1
$P3_0$ / $P3_3$	OUTPUT PORT 3
$P4_0$ / $P4_3$	INPUT/OUTPUT PORT 4
$P5_0$ / $P5_3$	INPUT/OUTPUT PORT 5
$P6_0$ / $P6_3$	INPUT OUTPUT PORT 6
INT1	INTERRUPT 1
X1, X2	CRYSTAL CLOCK INPUT, OUTPUT
CL1, CL2	SYSTEM CLOCK INPUT, OUTPUT
RESET	RESET
VLCD1-VLCD3	LCD POWER SUPPLY
VDD	POWER SUPPLY POSITIVE
VSS	GROUND
NC	NO CONNECTION

ST5046
860429

3.6.2 OQ0066A Programmable current source

GENERAL DESCRIPTION

The OQ066 is a programmable current source delivering 7 currents in the 10 nA to 10 mA range in decade steps. The output current is controlled by 3 digital range inputs. The principle is based on multiplication c.g. division of a reference current by means of current mirrors with dynamic element matching.
The reference current of 10 uA is derived from a precision current source with adjustable output current and temperature compensation.



ST4505
840727

Pinning OQ0066

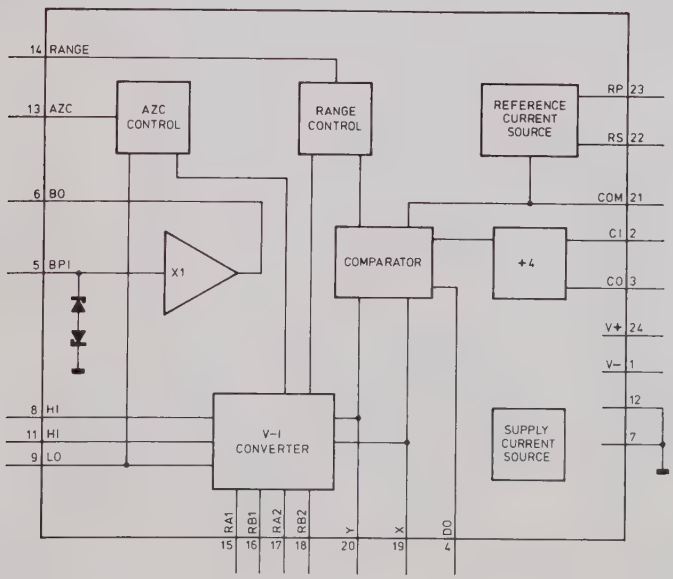
PIN DESCRIPTION: OQ0066A

1. IOUT Current output
2. +INP Op-Amp non inv. input
3. -INP Op-Amp inv. input
4. BUFO Buffer output
5. OPAO Op-Amp output
6. C1 Op-Amp comp. capacitor
7. VP Positive supply
8. C2 Mille comp. capacitor
9. COM Reference common
10. RS Ref. serial resistor
11. RP Ref. parallel resistor
12. GND Ground
13. ENA Enable input (low active)
14. CLI Clock input
15. RNGA Range A input
16. RNGB Range B input
17. RNGC Range C input
18. VN Negative supply

DIGITAL INPUT CODES

RNG	RNGB	RNGA	Factor	Output (Iref=10uA)
1	1	0	x 1000	10 mA
1	1	1	x 100	1 mA
0	0	0	x 10	100 µA
0	0	1	x 1	10 µA
0	1	0	x 0.1	1 µA
0	1	1	x 0.01	100 nA
1	0	0	x 0.001	10 nA
1	0	1	x t.b.f.	

3.6.3 OQ0067A BI-FET input ADC



Block diagram OQ0067A

DESCRIPTION

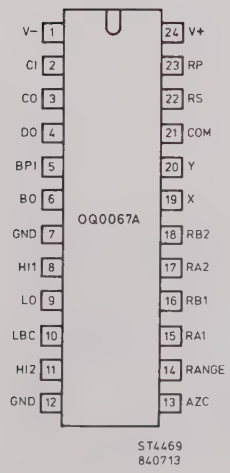
The OQ0067A is an ADC according to the Delta Modulator principle. It contains all the pats for a ADC. The output signal is an synchronus datasignal, which can be clocked in a microprocessor with a present clock. The display result is:

$$Disp = \frac{N \times Vin}{\frac{Iref \times Rconv}{2}}$$

N= the number of clockperiods during a measurement. The formule shows that the result will be more accurate with more clockperiods. This can be achieved with a longer measuring period or more clockpulses. To prevent offset voltages a AZC (auto zero compensation) input is available.

Every measuring period consists of two AZC periods. During the first AZC period the AZC input is logic low and the up counts the logic value of the datasignal on every edge of the clock. In the second AZC period the datasignal is inverted by the up. The up subtracts the logic value of the datasignal on every clock edge. At the same time the inputs of the ADC are interchanged. By this the input offset-voltage is eliminated. Via the range input a selection can be made between the two conversion resistors (input sensitivity 0.1V/1V).

PINNING & PIN FUNCTIONS



PIN NUMBER	NAME	DESCRIPTION
1	V -	Most negative supply & substrate
2	CI	Clock input
3	CO	ADC clock input
4	DO	ADC data output
5	BPI	Buffer & protection input
6	BO	Buffer output
8, 11	HI1,2	ADC HI inputs
9	LO	ADC LO input
10	LBC	Low buffer capacitor
7, 12	GND	Digital ground
13	AZC	AZC input
14	RANGE	Range input
15, 17	RA1,2	Range resistor A
16, 18	RB1,2	Range resistor B
19, 20	X, Y	Integrator capacitor
21	COM	Common point for current source resistor
22	RS	Series resistor Current source
23	RP	Parallel resistor
24	V^+	Most positive supply

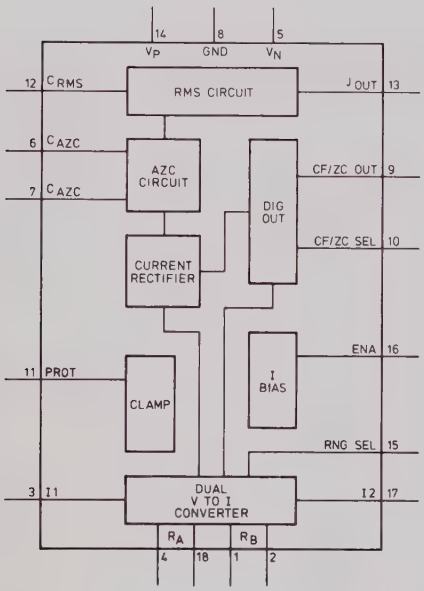
NOTE: pin numbers 7 and 12 are not connected together internally

Pinning OQ0067A

3.6.4 OQ0068A AC/DC convertor (RMS)

GENERAL DESCRIPTION

The OQ0068 is an integrated AC voltage to DC current convertor for use in measuring equipment.
The output current is proportional to the RMS value of the input voltage.
Special features are:
- Enable input for power-down mode
- Range input for selection of 2 resistor programmed ranges
- Crest Factor or Zero Crossing output selection
- Low leakage input clamp
- Automatic offset compensation



Blockdiagram OQ0068A

OPERATION MODES

ENA	SEL	CF/ZC	SEL RNG	FUNCTION
1		X	X	Power down mode
0		1	0	Low range measurement mode
0		1	1	High range measurement mode
0		0	0	Low range Counter mode
0		0	1	High range counter mode

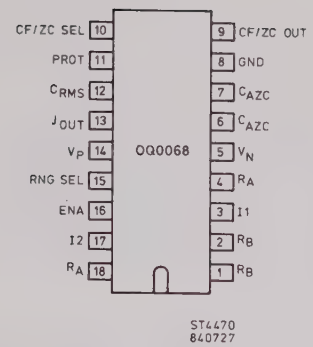


Figure 3.8 Pinning OQ0068A

PIN DESCRIPTION

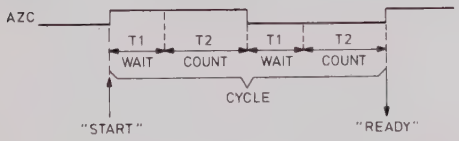
1 RB range resistor B
2 RB Range resistor B
3 I1 Input 1
4 RA Range resistor A
5 VN Negative supply
6 CAZ Autozero capacitor
7 CAZ Autozero capacitor
8 GND Ground
9 CF/ZC OUT Digital output
10 CF/ZC SEL Digital output select
11 PROT Input protection clamp
12 CRMS Integrating capacitor
13 IOUT Current output
14 VP Positive supply
15 RNG SEL Range selection
16 ENA Enable input
17 12 Input 2
18 RA Range resistor A

3.6.5 OQ0071 ADC interface

General

This device is designed as an ADC-interface with I^2C compatible serial data transfer. It contains two 16-bit (serial-in/parallel-out) shift registers, a 16 bit TIMER which can be parallel loaded from one of the two shift registers, a 16-bit serial-in/serial-out synchronic data counter, and a 7-bit presetable counter with an 8-bit serial-in/parallel-out register, in series with an 8-bit serial-in/parallel-out output-drive.

The main purpose of he device is to count the number of clock-pulses within a given time slot (T2; the "measuring time") in which the "DATA" input is opposite to the AZC output, plus the number of clock-pulses in another time slot (T2) in which the AZC-signal has been inverted. This time slot T2 is preceded by a waiting time (T1). The figure below explanes this sequence:



ST4408
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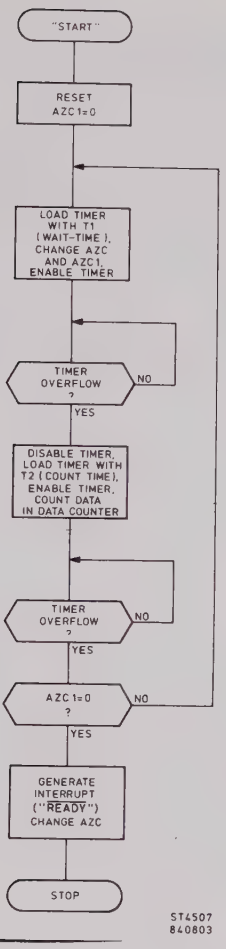
At the end of this cycle the device generates an ready signal (READY).
The sequence is started by the "STRT" command from the I^2C-interface and is controlled by the "sequence controller".

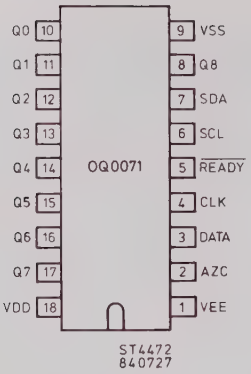
REMARK: The organisation should be such that when "DATA" is continuous "high" and the number in T_2 is N, that at the end of the count time, the contents of the counter is also N.



Flowchart of the sequence:

Besides this function, there is an independent 7-bit counter and 8-bit Output-driver. The 7-bit counter can be enabled or disabled, and is presentable with the 7 least significant bits of an 8-bits shift register.
The carry-signal from this counter loads the counter with the programmable preset and is devided by two to give the symmetrical signal QB. If this counter is disabled, QB is floating: if it is enabled, and the most significant bit of the 8-bit shift register is low, then the output QB is low, while if this bit is high, the output has a frequency of $f_{QB}=f_{ECLK}/2*$ (preset +2). In which preset is the value of the seven preset bits.
If this counter is preset with all high´s, the QB output will be kept high.

The 8-bit counter preset register, and the 8-bit Output shift registers are serialy coupled, to have a 16-bit data-transfer on the SDA-bus. But if the bleeper is enabled, a data transfer throuhg the 8-bit counter-preset-register should not be possible.
At the end of the 16-bit data transfer, the data in the 8-bit output shift register should be latched in the 8-output-drivers to update Q0 to Q7.
A logic zero in the shift register produces a logic one on the Q outputs.



OQ0071 Pinning

Pin no.	Name	Description
1	Vee	Negative supply voltage
2	AZC	Auto zero control output
3	DATA	Data signal input
4	ECL	Enable clock input
5	$\overline{\text{READY}}$	READY output
6	SCL	Serial clock (I^2C)
7	SDA	Serial data (I^2C)
9	Vss	Positive supply voltage
8, 10-17	Q0-8	Outputs
18	Vdd	Ground

3.7 I^2C BUS

The I^2C bus differs considerably from the conventional bus structures in that data-transfer is effected in a bit-serial, rather than in byte-parallel format.
In a conventional microcomputer such as the 8048 for instance, 12 address, 8 data and 4 control lines are necessary for parallel data transfer. The I^2C 8440 microcomputer, on the other hand requires only 2 lines to transfer serially the same amount of data. Chips used for ADC, RAM and LCD drivers are I^2C compatible and use also the same two lines.
These two lines are respectively the SDL (serial data line) and SCL (serial clock line), the function of which is to synchronise data-transfer between the appropriate I^2C devices.

Almost any number of devices can be connected to the I^2C bus. Each device is allocated its own specific 7-bit address which, enables any two of these devices to communicate with each other upon receipt of a message prefixed with the appropriate 7-bit address.
This specific 7-bit address usually comprises a fixed address part (4 bits), a user definable part (3 bits).
The latter being assignable by tying "Define Address" pins to high or low levels.
Address recognition is effected in the I^2C interface hardware of each device, and this eleminates the need for decoding logic. The use of an automatic-invoked arbitration procedure, which prevents two or more devices from transmitting simultaneously, makes I^2C technology eminently suitable for multiprocessor system.

For further information about I^2C see: Philips Data Handbook: Integrated circuits for digital systems in radio, audio and video equipment.

4. DISMANTLING THE INSTRUMENT

4.1 GENERAL INFORMATION

This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the instrument must be adequately protected against damage, and all normal precautions regarding the use of tools must be observed. During dismantling a careful note must be made of all disconnected leads so that they can be reconnected to their correct terminals during assembly.

4.2 DISMANTLING (all types)

The instrument is mounted without screws. All mechanical connections are snap shot connections.

- Remove the battery cover with a screwdriver
- Lift out the battery
- Bend out one hook and push it backwards with a screwdriver (4.1)
- Bend out the other hook and push it backwards too
- Pull the bottomcover from the topcover beginning at the top

NOTE: At the bottom two attach hooks are situated on the bottom cover. They hold the covers together.
At the top the battery springs are pushed in the pc board.
To release them pull firmly.

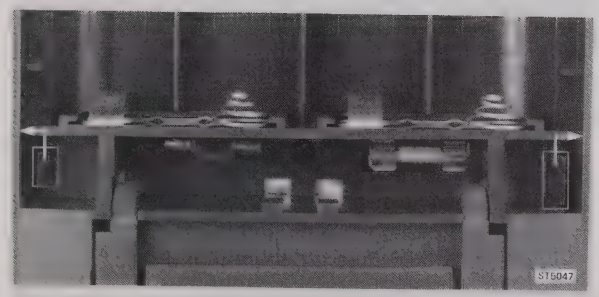


Figure 4.1 Bottom cover

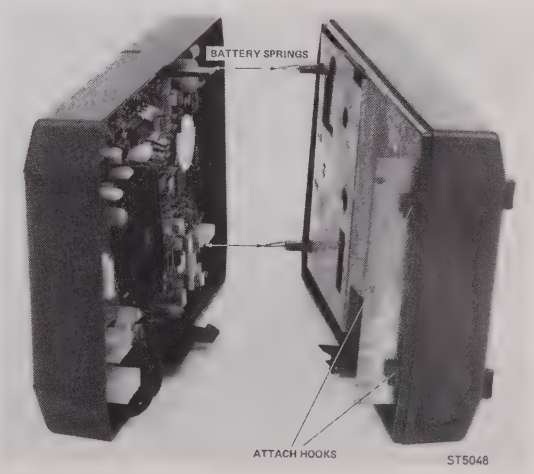


Figure 4.2 Opening the instrument

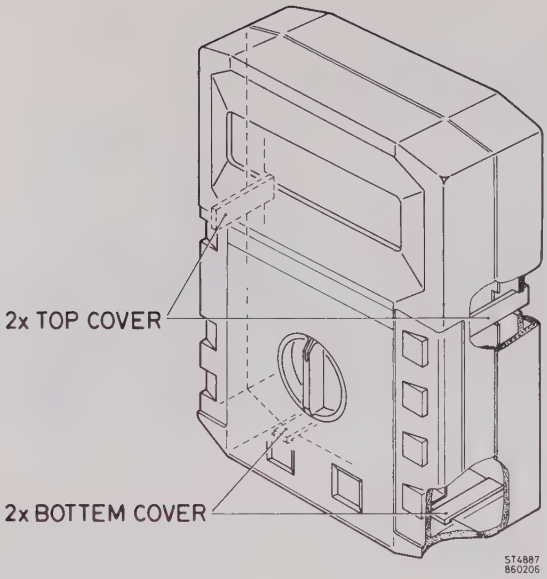


Figure 4.3 Attach hooks

4.3 REPLACING PARTS

4.3.1 Parts on the pc board (all types)

- Dismantle the instrument (refer to 4.2).
- Remove the input socket wiring from the pc board.

NOTE: The connections are very tight fit. Be careful when unplugging to avoid the printpens be pulled out of the board.

- Lift the pc board out of the topcover by pulling at the black part of the function selector (Fig. 4.4).

Figure 4.4 Disassembling the pc board

4.3.2 Function selector on the pc board (all types)

- Dismantle the instrument (refer to 4.2).
- Lift the pc board out of the topcover (refer to 4.3.1).
- The function selector consists of a ring and the slide rotor.
- Push rotor out of the ring of the conductor side of the pc board with a screw driver or a DIN-plug (Fig. 4.5).

NOTE: The function selector knob and rotor are keyed.

4.3.3 LX-display /01/11/31, window and interconnection rubber

- Dismantle the instrument (refer to 4.2).
- Lift the pc board out of the topcover (refer to 4.3.1).
- Push the LX attach lip out of the attach hole at the component side of the pc board with a pair of tweezers (Fig. 4.5).
- Lift the LX-display assembly from the pc board.

/01 only
- The assembly consists of three parts (Fig. 4.6). All three parts can be replaced separately.

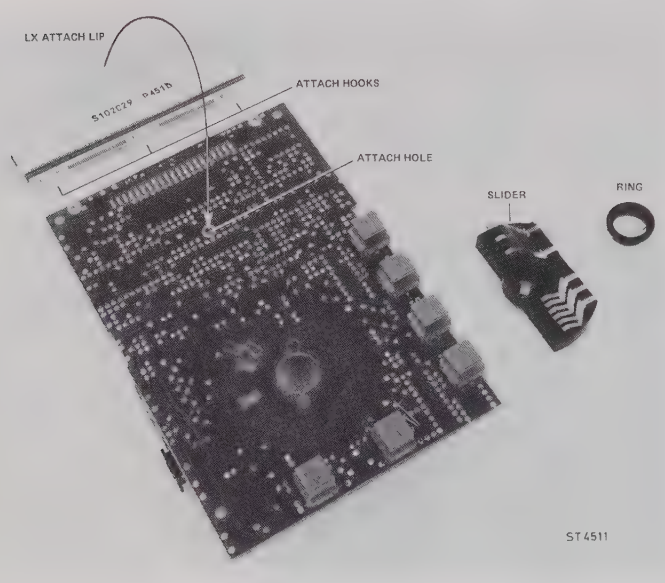


Figure 4.5 Disassembling the parts on the pc board

Figure 4.6 Disassembling the LX-display

/31/11 only
- The assembly consists of three parts.

The difference with respect to the /01 version is the liquid crystal display itself (no mirror in the /01 version).

Also for the /11 version an illumination foil is glued on the display.

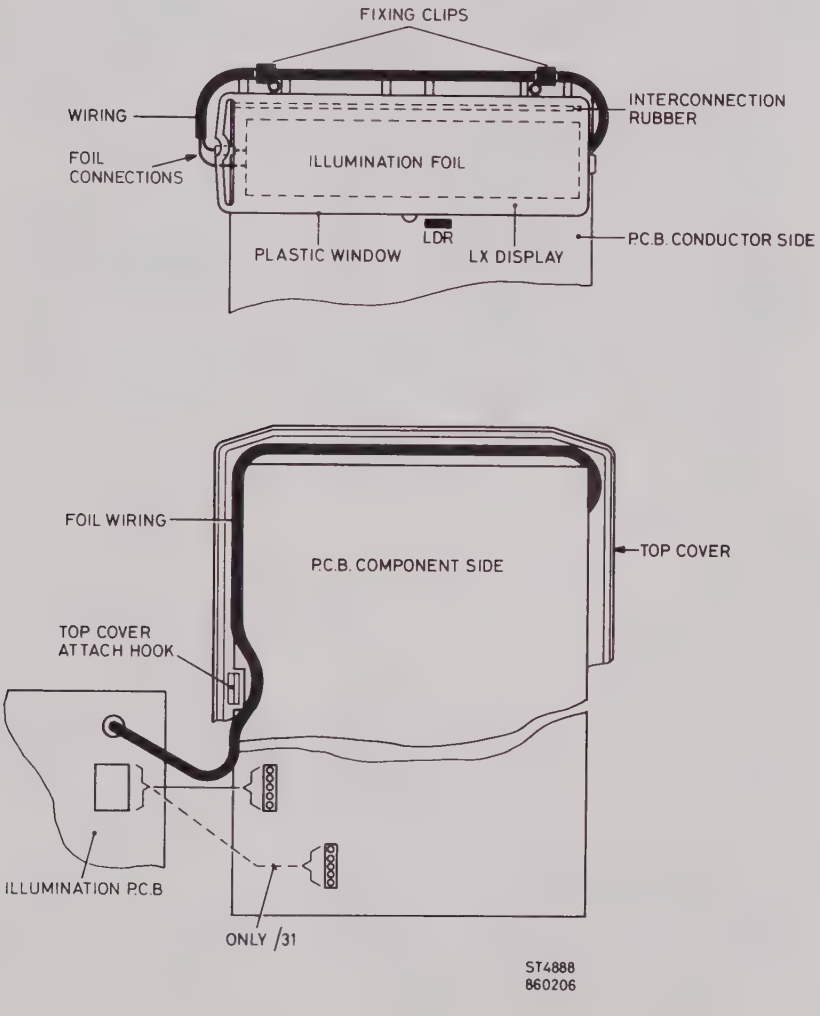


Figure 4.7 Replacing LX-display /11/31

REMARK
.Mount the foil wiring as shown, to avoid switching problems with the mode switches.
.The legs of the components under the LX-display must be kept as short as possible $\leq$ 1 mm).

4.3.4 Function selector and spring in the topcover /01/11/31

- Dismantle the instrument (refer to 4.2).
- Lift the pc board out of the topcover (refer to 4.3.1).
- Remove the screening out of the topcover (four screws).
- The function selector knob and the plastic spring are accesible now (Fig. 3.7)

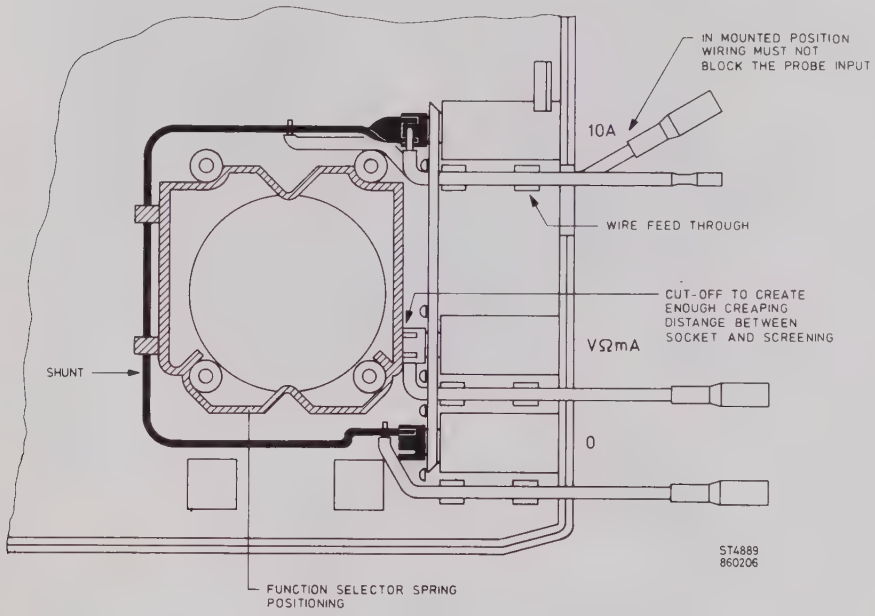


Figure 4.8 Disassembling the function selector knob.

4.3.5 Shunt and input sockets

If the shunt or input sockets are damaged they shoud be replaced by a complete new topcover assembly (including sockets, shunt assembly, spring function selector and screening).

4.3.6 mAs pc board /31 only

- Dismantle the instrument (refer to 4.2)
- Lift the screening out of the bottomcover
- Remove rubber rings from plastic pc board supports
- Lift the pc board out of the bottomcover

REMARK: Watch out not to damage the slide switch.

5. CHECKING AND ADJUSTING PM2618/01/11/31 & PM2718/01/11

5.1 GENERAL INFORMATION

The following information provides the complete checking and adjusting procedures for the instrument. As various control functions are interdependent, a certain order of adjustment is necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this Section are calibration guides, and should not be interpreted as instrument specifications unless theyare also published in Section 2.
- Tolerances given are for the instrument under test and do not includetest equipment error.
- All controls which are mentioned without item numbers are located on the outside of the instrument.

The calibration can be subdiveded into:

5.2 Preparations

5.3 Course adjustment (determine 2 resistors). Open instrument, manual.

5.4 Fine adjustment (3 adjustments). Open instrument, manual.

5.5 Specific version adjustment /11, /31. Open instrument, manual.

5.6 Electronic fine adjustment (16 adjustments). Instrument closed.

5.7 Calibration with IEEE interface and controller. Instrument closed.

Phases 5.2, 5.3 and 5.4 only have to be carried out when components have to be replaced.
Phase 5.5 up to 5.7 has to be carried out once a year to guarantee the specification.

Calibration overview		PM2618X			PM2718X			
No	Adjustment	/01	/11	/31	/01	/11	Chapter	Time table
1	Range 1 ADC OQ0067A	X	X	X	X	X	5.3 Coarse adjustment Open Instrument	Only if components have been replaced
2	Reference current OQ0066A	X	X	X	X	X		
3	LX-display voltage	X	X	X	X	X	5.4 Fine adjustment Open Instrument	
4	Zero ADC OQ0067A	X	X	X	X	X		
5	Compensation amplifier OQ0066A	X	X	X	X	X		
6	LDR		X	X		X	5.5 Specific version adjustments Open Instrument	
7	mAs Comparator + reference			X				
8	mAs Comparator - reference			X				
9	mAs offset voltage			X				
10	mAs Read out adjustment			X				
11	mAs Zero read out adjustment			X				
12a	1000 mV ⎓	X	X	X			5.6 Electronic fine adjustment Closed Instrument	Once a year
13a	10 V ⎓	X	X	X				
14a	100 V ⎓	X	X	X				
12b	1000 mV ⎓				X	X		
13b	10 V ⎓				X	X		
14b	100 V ⎓				X	X		
15	V ~ 10 V	X	X	X	X	X		
16	V ~ 100 V	X	X	X	X	X		
17	Hz 10 kHz	X	X	X	X	X		
18	Hz 100 kHz	X	X	X	X	X		
19	Ω 1 kΩ	X	X	X	X	X		
20	Ω 10 kΩ	X	X	X	X	X		
21	Ω 100 kΩ	X	X	X	X	X		
22	Ω 1 MΩ	X	X	X	X	X		
23	Ω 10 MΩ	X	X	X	X	X		
24	$0^{o}C$	X	X	X	X	X		
25	A ⎓ 20 mA	X	X	X	X	X		
26	A ⎓ 2 A	X	X	X	X	X		
27	A ~ 20 mA	X	X	X	X	X		

5.2 PREPARATIONS

- The instrument can be powered in the following ways:
  a. 4 x 1.5 V battery or PM9218A 9 V power supply
  b. A -5 V voltage supplied to capicitor C1801 (0 V to MP8, -5 V to MP9)
  Open instrument.

- It may be handy for repair and calibration purposes to use another instrument as a slave display (dummy). In chapter 6.2.2. is described how to do this.

- For coarse adjustment NO. 1 an additional help resistor of 14 kΩ, MR25, 1%, ordering number 5322 116 54629 has to be used.

- For fine adjustment NO. 5 an additional help resistor of 10 MΩ, VR25, 1%, ordering number 5322 116 51786.

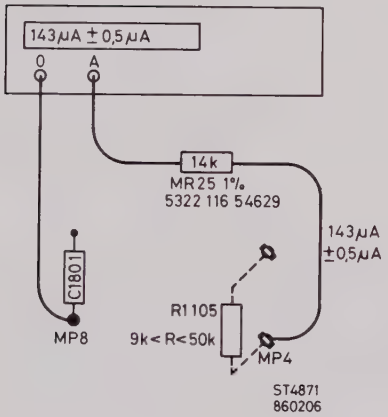


Figure 5.1 RANGE 1 ADC set-up 0Q0067A

5.3 Course adjustment (manual, open instrument, only if components have been replaced)

NO	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNALS	MEASURING DATA	MEASURING POINT
1	Range 1 ADC 0Q0067A	R1105 Adj. resistor (MR25, 1% E48 series) 9 kΩ < R < 50 kΩ	Instrument set in position, V ⎓ AUTO Use a uA meter e.g. PM2528 and a help resistor of 14 kΩ. See Fig. 6.1	-	+ 143 µA ± 0,5 uA	Refer to Fig. 5.1
2	Reference current 0Q0066A	R1410 Adj. resistor (MR25, 1% E48 series) 75 kΩ < R < 169 kΩ	Connect a µA meter e.g. PM2528 to : MP8 = Low MP6 = High Select: function Short cct input	-	+ 10 µA ± 0,05 uA	uA meter connected to VΩ mA and 0 input

END OF COARSE ADJUSTMENT

5.4 Fine adjustment (manual, open instrument, only if components have been replaced)

NO.	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNALS	MEASURING DATA	MEASURING POINT
3	LX-display voltage	Potentiometer R1803	Instrument on: V ⎓, AUTO	-	+ 3,2 V ±0,01 V	High= MP7 Low = MP8
4	Zero ADC OQ0067A	Trimmer C1111	Instrument on: V ⎓, AUTO	Shortcircuit VΩ mA and 0-socket	+ 000.0 mV ±1 dig.	Display
5	Compensation amplifier OQ0066A	Potentiometer R1406	a. -Instrument on: Range 10MΩ -Measure the measuring current (100 nA +_ 0,1 nA) with a μA meter e,g, PM2528 and note it down. b. -Place a resistor of 10 MΩ is series with the PM2528. -Adjust the current with R1406 to the same value as in a.	-	Same value a=b.	μA meter VΩ mA and 0 input. Refer to Fig. 5.2

END OF FINE ADJUSTMENT

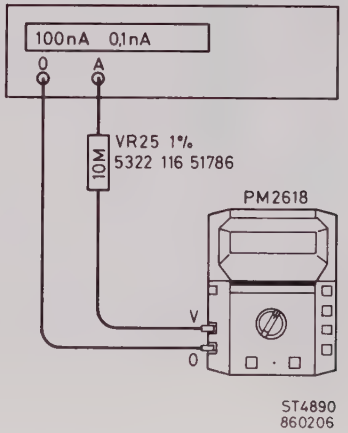


Figure 5.2 I comp OQ0066

Remarks: If the lastdigit on the display of the PM2618X/PM2718X is a "n" (no calibration mode) first carry out adjustments 6, 7 and 8.

5.5 SPECIFIC VERSION ADJUSTMENT /11, /31.

5.5.1 LDR ADJUSTMENT for /11 and /31 version

Adjustment no. 6 LDR ADJUSTMENT

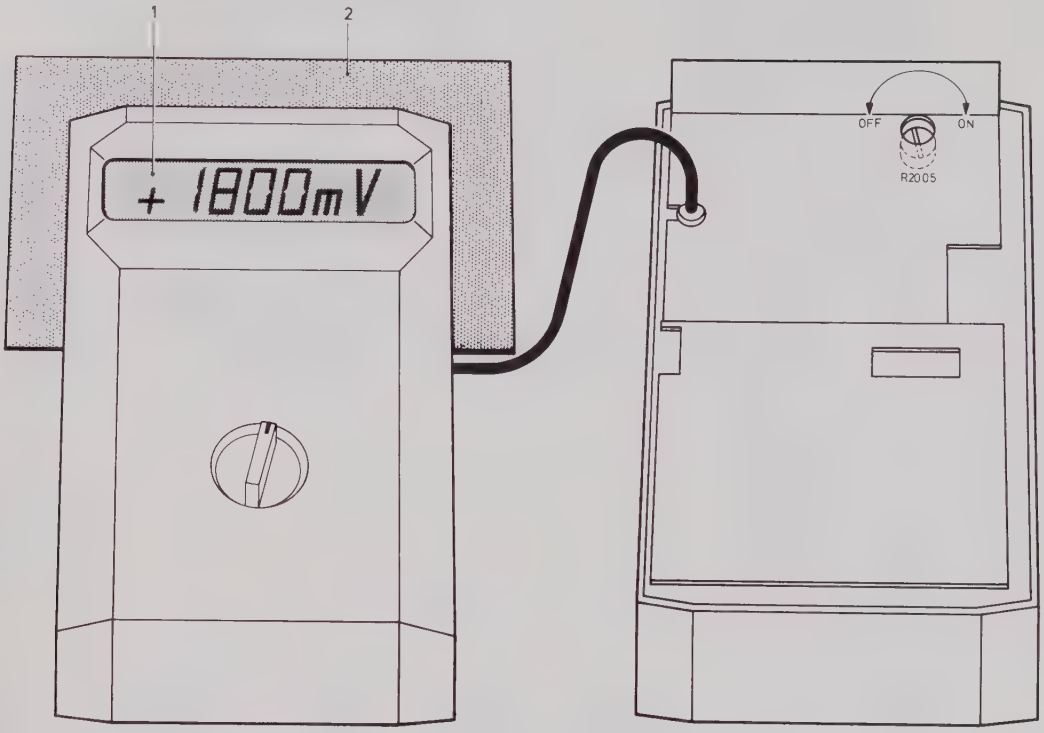


Figure 5.3 LDR adjustment

- Place the topcover with display upwards.
- 1. Make sure that the LDR is placed in the correct position.
  Make sure that the display window is pressed firmly and correct to the topcover.
- 2. Press a piece of black material (foam, carton) to the back of the topcover.
- Adjust the illumination to off under normal light circumstances (switching-off point).
- Check on, off with a hand above the display.

No	ADJUSTMENT	ADJUSTING ELEMENT	PREPARATIONS	INPUT SIGNAL	MEASURING DATA	MEASURING POINT
7	+ Reference	Potentiometer R 2030	- Turn R2029 to the left - PM2618/31 A ⎓ range function: mAs - Keep mAs switch for 2 seconds in position erase	+0,4 mA ±2µA connected to VA and 0 socket	Voltage must switch from the positive to the negative voltage. +8V ┐ └ -8V When TP 1 stays negative, remove R2039 When TP 1 stays positive, remove R2034	Measure voltage between TP 1 and 0 socket.
8	- Reference	Potentiometer R2029	- PM2618/31 A ⎓ range function: mAs	-0,4 mA ±2 µA connected to VA and 0 sockets	Voltage must switch from the positive to the negative voltage +8V ┐ └ -8V When TP 1 stays negative, remove R2038 When TP 1 stays positive, remove R2037	Measure voltage between TP 1 and 0 socket
9	Offset voltage	Potentiometer R2016	- PM2618/31 A ⎓ range function: mAs - connect gate (on R2010) with pulse ┌┐ 0V └┘ -5V pulsewidth 1 sec.	200 mA connected to VAΩ and 0 socket	0,00 V ±15 uV	Measure voltage between TP 2 and 0 socket.
10	Display read out adjustment	Adjusting resistor (MR 25 1% E48 Series). R2026 (coarse) Potentiometer R2024 (Fine)	- Turn R2024 in centre position - Connect resistance box (71k5-121k) on mounting pens R2026 - PM2618/31 A ⎓ range function: mAs - keep mAs switch for 2 seconds in position erase. Connect gate (on R2010) with pulse 0 -5V ┌┐ pulsewidth 1 sec.	+ 200 mA connected to VAΩ and 0 socket	200.0 ±2 digits	Display
11	Adjust zero read out	Potentiometer R2019	- PM2618/31 A ⎓ range function: erase	No current	0 digits	Display

5.6 ELECTRONIC FINE ADJUSTMENT (housing closed, once a year)

Select the ELECTRONIC CALIBRATION MODE in the following way:

a. Select function Hz.
b. Switch off the PM2618.
c. Shortcircuit the two testpins X1017 (or MP15 and MP16) that are situated in the round hole in the battery compartment with e.g. a screwdriver. "A"
d. Switch on the instrument while shortcircuiting. (last digit "c")

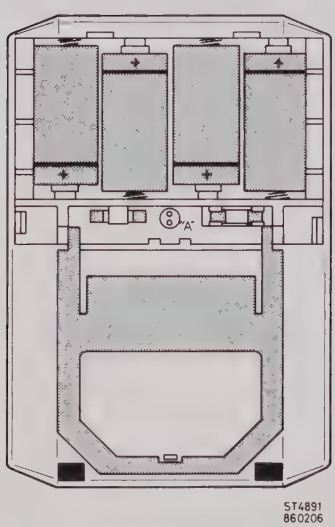


Fig. 5.4. Electronic adjustment

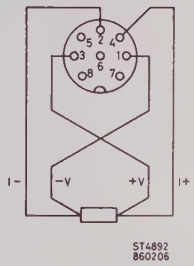
The electronics calibration also can be performed with a IEEE-controller and the IEEE/IEC interface PM9181. In this way it is possible with the aid of a programmable calibrator (IEEE) to do automatic calibration (Refer to chapter 5.7.1.).

Use the following procedure for all calibration lines.

a. Select function
b. Select range
c. Connect wanted input signal
d. Press button "ZERO" (or 2x SHIFT)

The last digit on the display shows the state of calibration.

n = No cal (error, only if RAM is replaced)
C = Cal mode on
r = Calibration ready (next)
F = Calibration failed (repeat)

No.	Select	Supply	
12a	V ⎓ AUTO*	1000 mV ⎓ ±0,001%	PM2618 only for
13a		10 V ⎓ ±0,001%	PM2718 refer to
14a		100 V ⎓ ±0,001%	table below
15	V~ AUTO	10 V~ 60 Hz ±0,01%	
16		100 V~ 60 Hz ±0,01%	
17	Hz AUTO	10 kHz square wave ±0,02% > 1 Vpp < 10 Vpp or sine wave	
18		100 kHz square wave ±0,02% > 1 Vpp < 10 Vpp or sine wave	
19	Auto	1 kΩ ±0,01%	
20		10 kΩ ±0,01%	
21		100 kΩ ±0,01%	
22		1 MΩ ±0,01%	
23		10 MΩ ±0,01%	
24	0 °C	100Ω NOTE: The resistance should be connected the probe input.	
25	A ⎓ AUTO	20 mA ⎓ ±0,2%	
26		2 A ⎓ ±0,2%	
27	A~ AUTO	20 mA~ 60 Hz ±0,2%	

* 12a - 14a PM2618/01/11/31 only.

PM2718/01/31 ONLY

The adjustments of the V ⎓ function have to be carried out with an accuracy of ± 1 digit on the display. Due to the electronic calibration the adjustments may have to be repeated.

Proceed als follows:

No.	Select	Supply	Display *
12b	V ⎓ Auto	1000 mV ⎓ ±0,001%	1000.0 mV ±1 digit
13b	V ⎓ Auto	10 V ⎓ ±0,001%	10.000 mV ±1 digit
14b	V ⎓ Auto	100 V ⎓ ±0,001%	100.00 V ±1 digit

CONTINUE WITH ADJUSTMENT NO. 15.

*If the display shows another value, adjust the calibration to that value and repeat the adjustment.
Example:
Supply 1000.0 mV ⎓ ⟶ Display 1000.5 mV
Supply 1000.5 mV ⎓ ⟶ Display 1000.0 mV ±1 digit

Supply 1000.0 mV ⎓ ⟶ Display 999.4 mV
Supply 999.4 mV ⎓ ⟶ Display 1000 mV ±1 digit

5.7 Electronic calibration with IEEE-488 interface PM9181 and IEEE-488 controller.

With the interface PM9181, the controller (eg. P2000C) and a programmable IEEE-488 calibrator (e.g. Fluke 5100B) it is possible to do automatic testing and calibrating of the multimeter.

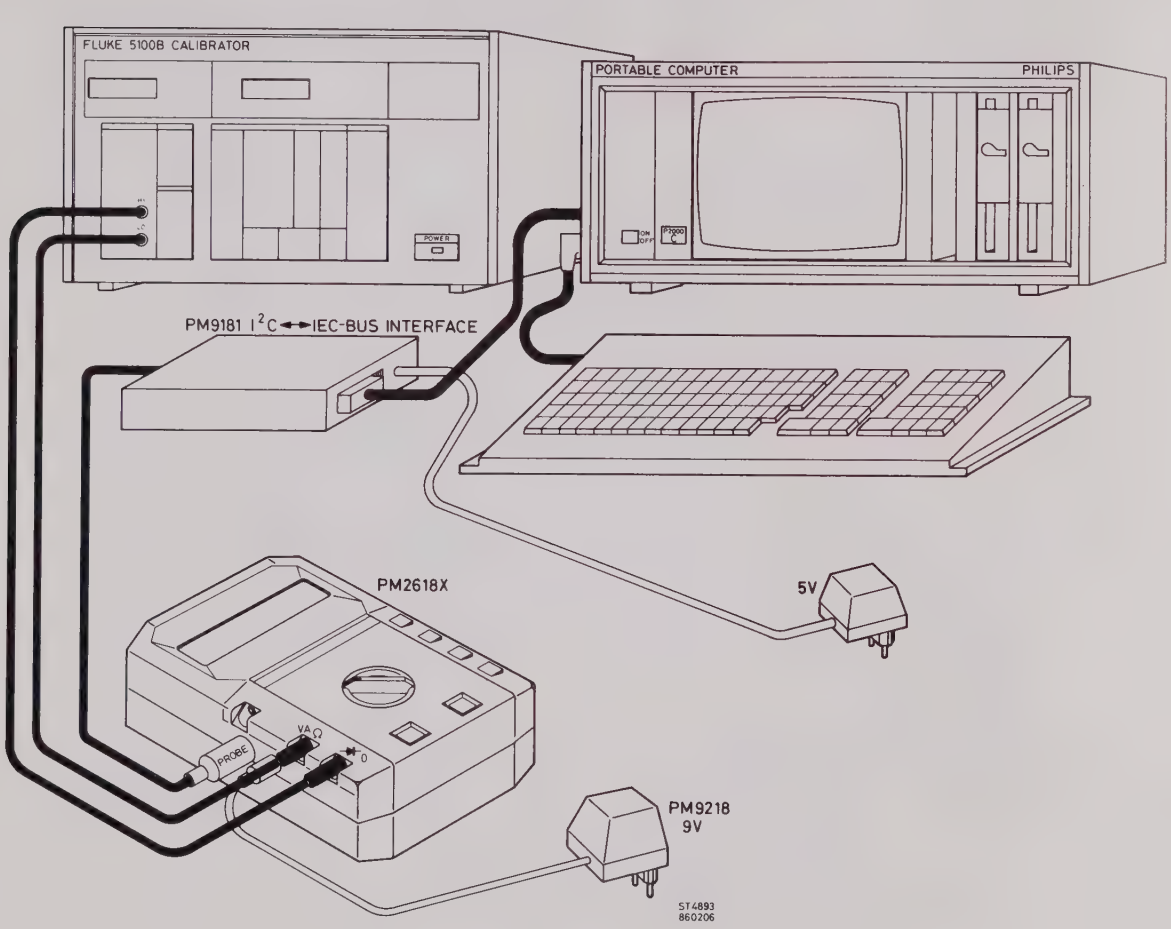


Figure 5.5. Automatic test- and calibration set-up

5.7.1 Device programming of PM2618X/PM2718X in combination with IEEE interface PM9181.

5.7.1.1 Input data:

The following are programmable:

Range;	R 0	autoranging
	R n	n=range number 1-6
Calibration*	C 1	calibration mode ON
	C 0	calibration mode OFF
Execute	X 1	trigger
Interface test	TSI U	(output F if failed)
Identity	ID ?	(output PM2518F) = PM2518 Family
Separators	SPR n	
Service Request	MSR n	

* To activate new calibration value´s switch PM2618X/PM2718X off and on, or change function.

5.7.1.2 Output data:

Measurement output is given as a string of 10 characters:
The first character denotes the function range number:
ASC (A$)=40+Furarn
The second is always a space.
The third is

0	overload (value is meaningless)
U	underload (value is meaningless)
C	crest factor overload
Z	relative value
sp	no Overload or Underload or relative

The fourth is always a space.
The fifth is the sign of the value.
The next five characters are the display value.
The last character is a space, if the output is in dB it is a B.

Status byte:
Bit 0=1 data available
Bit 1,2 indicate the calibration result;

00	idle mode (after a trigger: range cannot be calibrated)
01	calibration busy
10	calibration ready & succes full
11	calibration failed

all other bits (exept SRQ) always 0

The definition of the first character in the string;

A$	ASC(A$)	function/range	number
@	64	1 VAC	0
A	65	10 VAC	1
B	66	100 VAC	2
C	67	1000 VAC	3
D	68	1 VDC	4
E	69	10 VDC	5
F	70	100 VDC	6
G	71	1000 VDC	7
H	72	20 mAC	8
I	73	200 mAC	9
J	74	2 AAC	10
K	75	20 AAC	11
L	76	20 mDC	12
M	77	200 mDC	13
N	78	2 ADC	14
O	79	20 ADC	15
P	80	TMP	16
Q	81	DIO	17
R	82	1 kohm	18
S	83	10 kohm	19
T	84	100 kohm	20
U	85	1 Mohm	21
V	86	10 Mohm	22
W	87	100 Mohm	23
X	88	20 kHz	24
Y	89	200 kHz	25
Z	90	LOGIC	26

6. CORRECTIVE MAINTENANCE

6.1 REPLACEMENTS

6.1.1 Special parts

In addition to the standard electronic components, some special components are used:
- Components, manufactured or selected by Philips to meet specific performance requirements.
- Components which are important for the safety of the instrument.

ATTENTION: Both type of components may only be replaced by components obtained through your local Philips organisation or representative. These components have been marked in the Parts List.

6.2 BUILT-IN TESTS FOR CALIBRATION AND FAULTFINDING

6.2.1 How to switch on the tests.

a. Select function.
b. Switch-off the instrument.
c. Shortcircuit the two testpins X1017 (or MP15 and MP16) that are situated in the round hole in the battery compartment, with a screwdriver.
d. Switch on the instrument while shortcircuiting.
e. To exit switch-off the instrument.

6.2.2 Available tests

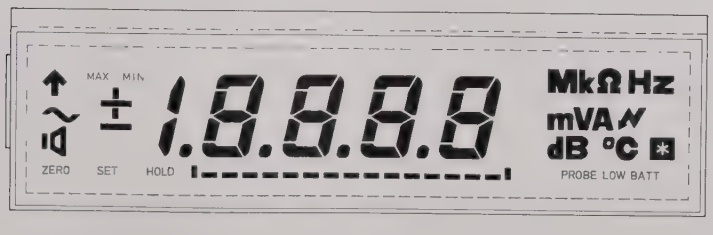
	Function	X1017	Description
a.	Hz	Shortcct	CAL mode
b.	Ω	,,	LCD test
c.	V⎓	,,	Master transmitter
	mA	,,	Slave receiver
d.	Cont	,,	Port mode
e.	V~	,,	No cal mode

a. Cal mode (Hz)

Refer to chapter 3.1.

b. LCD test (Ω)

The Liquid Crystal Display (LCD) will show all segments to check all connections.



c. Master transmitter/Slave receiver

For calibration and repair purposes it is handy to use another instrument as a slave display (dummy). In the device under test (DUT) the display is at the back of the pc board.

Proceed as follows:

Slave receiver (dummy)

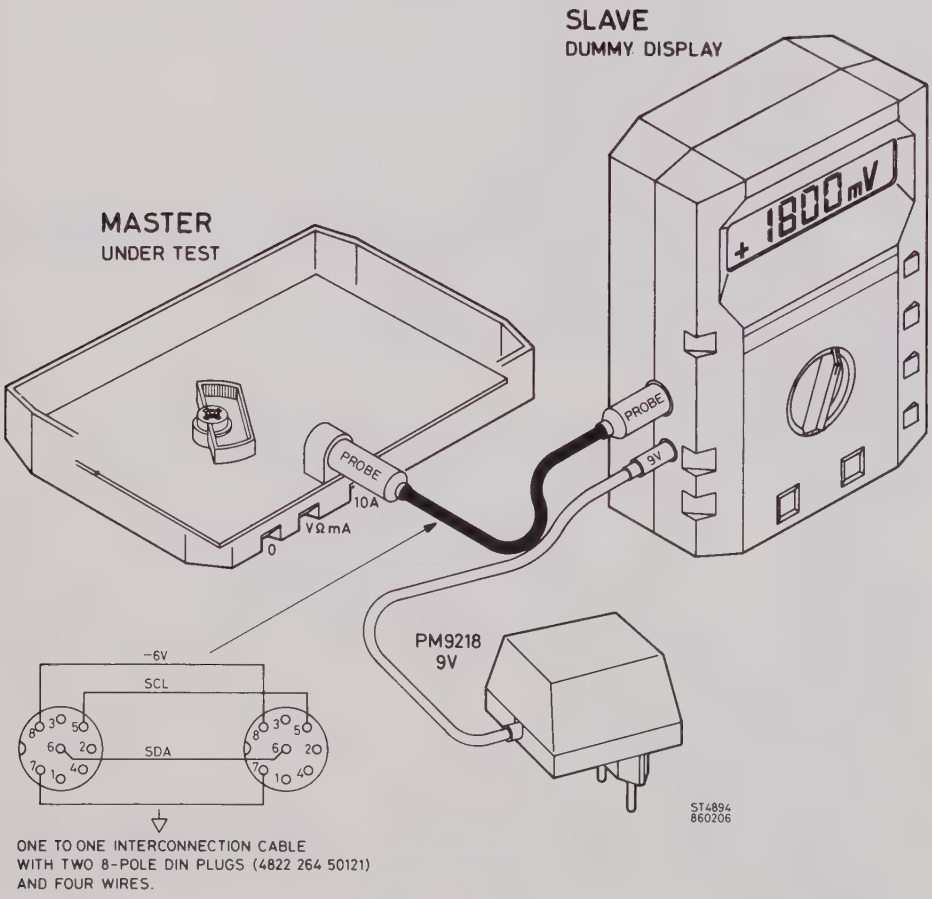
-Remove restistors R1704/05/06/06.

-Select function mA, shortcct. X1017 and switch on the slave PM2618X.

Master transmitter (DUT)

-Select function V ⎓, shortcct X1017 and switch on the master.

TEST AND CALIBRATION SET-UP WITH "DUMMY DISPLAY"



I^2C interconnection cable

d. Port mode (Cont)

In this mode the switch connections to the micro-proccessor and the correct read by the micro-proccessor can be tested. On the display a four-character word indicates the test result.

SWITCH POSITION	DISPLAY	
	BATTERY SUPPLY	PM9218A SUPPLY
CONT 🔊	2AAF	2A8F
Ω	29AF	298F
V⎓	2EAF	2E8F
V~	2FAF	2F8F
Hz	27AF	278F
°C	A6A7	A68F
A⎓	2CAF	2C8F
A⎓	2dAF	2d8F
A⎓ +ZERO	2d2F	2d0F
A⎓ +CLEAR	2dEA	2d8E
A⎓ +RNG*	2dAd	2d8d
A⎓ +AUTO	2dAb	2d8b
A⎓ +FUNCTION	2dA7	2d87
A⎓ +10 A bus	4dA7	4d8F

e. NO CAL mode (V~)

The instrument will ignore the stored (RAM) calibration values. In case of a bad calibrated instrument (last digit = n) the instrument will continue measuring. This is ment for repair purposes only.

7. PARTS LIST

⚠ ☐ When servicing, use only specified replacement parts.

7.1 MECHANICAL PARTLIST PM2618X/01/11/31 PM2718/01/11

Topcover	Codenr.	Fig.	ITEM	Qty
Topcover assembly PM2618X/01/11/31 Incl. knob, shunt assembly, screening, arret spring, bleeper.	5322 447 90619	-	-	1
Topcover assembly PM2718X/01/11 Incl. knob, shunt assembly, screening, arret spring, bleeper.	5322 447 90621	-	-	1
Arret spring	5322 405 90281	7.1	1	1
Function knob	5322 414 40026	7.1	2	1
P.C. board				
Rotor assembly	5322 362 20226	7.2	1	1
Rotor ring	5322 532 60932	7.2	2	1
Rotor insulation	5322 466 91519	7.2	5	1
Pushbutton switch	4822 276 11076	7.2	3	6
Pushbutton knob	5322 414 20075	7.2	4	5
Printpen Hi/Lo/shunt	5322 268 14031	8.5	X1004/6/7	3
Printpen 10A	5322 268 14156	8.5	X1005	1
8-P Din socket	5322 267 54107	8.5	X1008	1
9V socket HEC0739-01-010	4822 267 30431	8.5	X1015	1
Fuse holder	5322 256 34097	8.5	F1001	1
Display assy (window, rubber, display)				
LX display assembly /01	5322 694 54029	-	-	1
LX display assembly /11, /31	5322 694 54031	-	-	1
Bottom cover				
Bottom cover (without feat, screening, battery springs)	5322 447 90433	7.3	1	1
Battery spring +/-	5322 492 63047	7.3	2	2
Battery spring interconnection	5322 492 63048	7.4	1	3
Contact plate	5322 290 60571	7.4	2	4
Stand-up bracket	5322 462 40689	-	-	1
Probe shutter	5322 447 70082	7.3	4	1
Battery cover	5322 443 61299	-	-	1
Fuse 630 mAF	4822 253 20015	-	-	1
Test connector	5322 265 20266	-	-	
Rubber foot	5322 462 40691	7.3	3	4
Bleeper	5322 280 10158	7.3	5	1

Measuring leads

Set of measuring leads (incl. pins and adaptors)	5322 397 60086
Testpin black	5322 264 20045
Testpin red	5322 264 20046
Lead black	5322 321 20572
Lead red	5322 321 20573
Adaptor black	5322 264 20052
Adaptor red	5322 264 20051

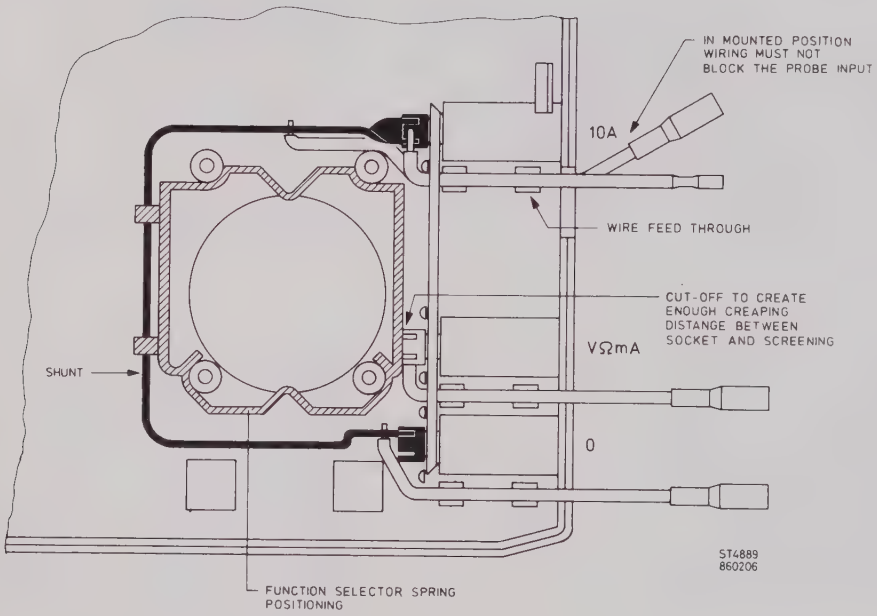


Figure 7.1 Top cover

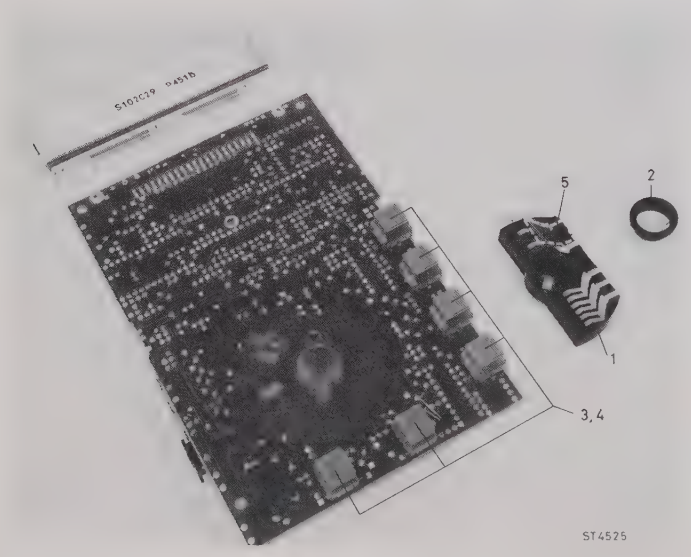


Figure 7.2 Pc board

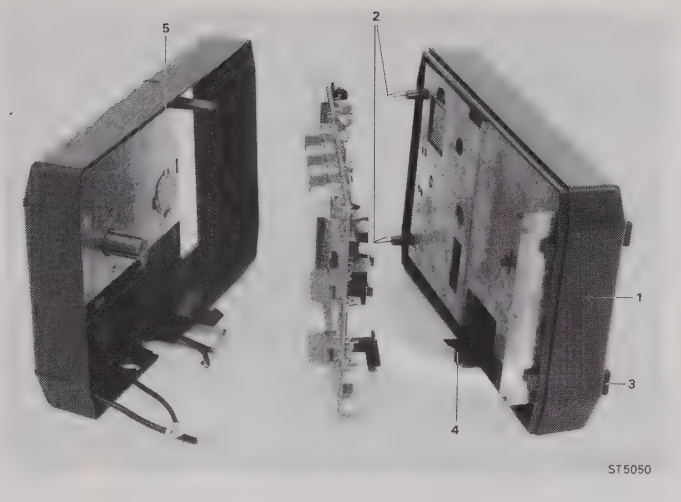


Figure 7.3 Bottom cover

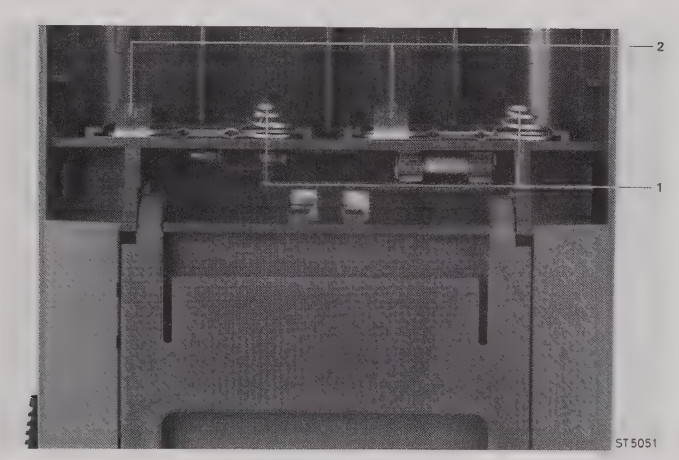


Figure 7.4 Battery compartment

7.2 ELECTRICAL PARTSLIST

All types and versions PM2618X/01 PM2718X/01

7.2.1 Resistors

Posnr.	Description	Ordering code
R 1101	0.1% 1K78	5322 116 51776
R 1102	0.1% 17K8	5322 116 52387
R 1103	0.1% 8K76	5322 116 52117
R 1104	MR25 1% 1K15	5322 116 52121
R 1105	MR25 1% 196K	5322 116 55364
R 1106	MR25 1% 30E1	5322 116 50904
R 1107	MR25 1% 1M	5322 116 55535
R 1108	MR25 1% 46K4	5322 116 50557
R 1109	MR25 1% 110K	5322 116 54701
R 1110	MR25 1% 61K9	4822 116 51265
R 1201	SPEC 0.25% 4M53	5322 116 52126
R 1202	SPEC 0.25% 4M53	5322 116 52126
R 1203	MR25 1% 51K1	5322 116 50672
R 1204	MR25 1% 51E1	5322 116 54442
R 1205	0.1% 7K57	5322 116 52118
R 1206	0.1% 825K	5322 116 52119
R 1207	0.1% 825K	5322 116 52119
R 1208	MR30 1% 110K	5322 116 55485
R 1301	VR37 1% 1M	5322 116 64006
R 1302	VR37 1% 1M	5322 116 64006
R 1303	0.1% 196K	5322 116 52386
R 1304	0.1% 1K803	5322 116 52388
R 1305	MR25 1% 23K7	5322 116 54646
R 1306	0.1% 3K01	5322 116 51777
R 1307	0.1% 30K1	5322 116 51781
R 1308	MR25 1% 23E7	5322 116 54014
R 1309	MR25 1% 9K53	5322 116 55574
R 1310	MR25 1% 100K	4822 116 51268
R 1311	MR25 1% 100K	4822 116 51268
R 1312	MR25 1% 402E	5322 116 54519
R 1313	MR25 1% 20K5	5322 116 55419
R 1314	MR25 1% 20K5	5322 116 55419
R 1315	VR25 5% 2M	5322 116 60135
R 1316	VR25 5% 10M	4822 110 72214
R 1317	MR25 1% 1K	4822 116 51235
R 1401	245V 750E-1K5	5322 116 44006
R 1402	245V 750E-1K5	5322 116 44006
R 1403	245V 750E-1K5	5322 116 44006
R 1404	VR25 1% 10M	5322 116 51786
R 1405	MR25 1% 28K7	5322 116 55462
R 1406	CTP10 20% 470E	4822 100 10038
R 1407	MR25 1% 28K7	5322 116 55462
R 1408	0.1% 121K	5322 116 51774
R 1409	MR25 1% 16K9	5322 116 54635
R 1410	MR25 1% 147K	5322 116 54712
R 1601	1W 20% 50E	4822 116 30008
R 1602	1% 1E0	5322 113 21004
R 1701	MR25 1% 1K	4822 116 51235
R 1702	MR25 1% 100K	4822 116 51268
R 1703	MR25 1% 100K	4822 116 51268
R 1704	MR25 1% 100E	5322 116 55549
R 1705	MR25 1% 100E	5322 116 55549
R 1706	MR25 1% 100E	5322 116 55549
R 1707	MR25 1% 100E	5322 116 55549
R 1708	MR25 1% 10K	4822 116 51253
R 1709	MR25 1% 100E	5322 116 55549
R 1710	MR25 1% 100E	5322 116 55549
R 1711	MR25 1% 100K	4822 116 51268

Posnr.	Description	Ordering code
R 1712	MR25 1% 46K4	5322 116 50557
R 1713	MR25 1% 1K	4822 116 51235
R 1714	MR25 1% 100K	4822 116 51268
R 1715	MR25 1% 205K	5322 116 55387
R 1716	MR25 1% 100K	4822 116 51268
R 1717	MR25 1% 402K	5322 116 55283
R 1718	MR25 1% 46K4	5322 116 50557
R 1719	MR25 1% 46K4	5322 116 50557
R 1720	MR25 1% 5K11	5322 116 54595
R 1721	MR25 1% 24K9	5322 116 54648
R 1722	MR25 1% 24K9	5322 116 54648
R 1723	MR25 1% 1K	4822 116 51235
R 1724	-105-473 47K	5322 111 90808
R 1725	-105-473 47K	5322 111 90808
R 1726	MR25 1% 10K	4822 116 51253
R 1801	MR25 1% 715E	5322 116 50571
R 1802	MR25 1% 4K87	5322 116 55445
R 1803	CTP10 20% 22K	4822 100 10051
R 1805	MR25 1% 11K	5322 116 54623
R 1806	MR25 1% 11K	5322 116 54623
R 1807	MR25 1% 44K2	5322 116 55449
R 1808	MR25 1% 464K	5322 116 55207
R 1809	MR25 1% 316K	5322 116 55268
R 1810	MR25 1% 249K	5322 116 54734
R 1811	MR25 1% 46K4	5322 116 50557
R 1812	MR25 1% 1K05	4822 116 52898
R 1813	MR25 1% 10E	5322 116 50452
R 1814	MR25 1% 10E	5322 116 50452
R 1815	MR25 1% 11K	5322 116 54623

7.2.2 Capacitors

Posnr.	Description	Ordering code
C 1101	2% 100PF	4822 122 31316
C 1102	2% 100PF	4822 122 31316
C 1103	250V 10% 47NF	4822 121 41676
C 1104	2% 47PF	4822 122 31072
C 1105	2% 100PF	4822 122 31316
C 1106	2% 100PF	4822 122 31316
C 1107	-20+80% 22NF	4822 122 30103
C 1108	-20+80% 22NF	4822 122 30103
C 1109	-20+80% 22NF	4822 122 30103
C 1110	2% 47PF	4822 122 31072
C 1111	250V 1.2/6PF	4822 125 50077
C 1112	0.25PF 3.3PF	4822 122 31821
C 1113	-20+50% 10NF	4822 122 31414
C 1114	-20+80% 22NF	4822 122 30103
C 1115	-20+80% 22NF	4822 122 30103
C 1116	-20+80% 22NF	4822 122 30103
C 1201	630V 5% 5.6NF	4822 121 50595
C 1202	400V 10% 33NF	5322 121 44025
C 1301	400V 10% 68NF	4822 121 42078
C 1302	0.25PF 3.3PF	5322 122 32549
C 1303	0.25PF 3.9PF	4822 122 31217
C 1304	10% 2.7NF	4822 122 30057
C 1306	100V 10% 680NF	5322 121 40233
C 1307	2% 100PF	4822 122 31316
C 1308	10V 20% 15UF	5322 124 14036

Posnr.	Description	Ordering code
C 1309	10V 20% 4.7UF	4822 124 10367
C 1310	10V 20% 4.7UF	4822 124 10367
C 1311	100V 10% 220NF	4822 121 40232
C 1312	2% 33PF	5322 122 32551
C 1313	-20+50% 10NF	4822 122 31414
C 1314	25V 20% 1UF	4822 124 20944
C 1315	0.25PF 1PF	4822 122 30104
C 1401	250V 10% 22NF	4822 121 41587
C 1402	10% 1NF	4822 122 30027
C 1403	-20+50% 10NF	4822 122 31414
C 1404	-20+50% 10NF	4822 122 31414
C 1405	-20+80% 22NF	4822 122 30103
C 1406	-20+80% 22NF	4822 122 30103
C 1701	-20+80% 22NF	4822 122 30103
C 1702	2% 33PF	5322 122 32072
C 1703	-20+80% 22NF	4822 122 30103
C 1704	-20+80% 22NF	4822 122 30103
C 1705	-20+80% 22NF	4822 122 30103
C 1706	-20+80% 22NF	4822 122 30103
C 1707	-20+80% 22NF	4822 122 30103
C 1708	-20+80% 22NF	4822 122 30103
C 1709	-20+80% 22NF	4822 122 30103
C 1710	-20+80% 22NF	4822 122 30103
C 1711	-20+80% 22NF	4822 122 30103
C 1712	-20+80% 22NF	4822 122 30103
C 1713	-20+80% 22NF	4822 122 30103
C 1714	-20+80% 22NF	4822 122 30103
C 1715	-20+80% 22NF	4822 122 30103
C 1716	10% 1NF	4822 122 30027
C 1717	2% 150PF	4822 122 31085
C 1719	-20+80% 22NF	4822 122 30103
C 1720	-20+80% 22NF	4822 122 30103
C 1721	-20+80% 22NF	4822 122 30103
C 1801	-10+50% 100UF	4822 124 20679
C 1802	10V 20% 15UF	5322 124 14036
C 1803	10V 20% 15UF	5322 124 14036
C 1804	10V 20% 15UF	5322 124 14036
C 1805	-20+80% 22NF	4822 122 30103
C 1806	-20+80% 22NF	4822 122 30103

7.2.3 Semiconductors

Posnr.	Description	Ordering code
V 1101	BC549C PEL	4822 130 44246
V 1201	BF256B PEL	5322 130 44744
V 1202	BF256B PEL	5322 130 44744
V 1301	BF256B PEL	5322 130 44744
V 1302	BF256B PEL	5322 130 44744
V 1351	BAW62 PEL	4822 130 30613
V 1451	BAX12 DO-35 PEL	5322 130 34605
V 1452	BAX12 DO-35 PEL	5322 130 34605
V 1453	BZX87-C5V1 PEL	5322 130 34425
V 1701	BC559B PEL	4822 130 44358
V 1751	BAW62 PEL	4822 130 30613
V 1752	BAW62 PEL	4822 130 30613
V 1753	BAT85 PEL	4822 130 31983
V 1754	BAT85 PEL	4822 130 31983
V 1801	BC559B PEL	4822 130 44358
V 1802	BC559B PEL	4822 130 44358
V 1803	BC549C PEL	4822 130 44246
V 1804	BC559B PEL	4822 130 44358

Posnr.	Description		Ordering code
V 1805	BC549C	PEL	4822 130 44246
V 1851	BAX12 DO-35	PEL	5322 130 34605
V 1852	BAX12 DO-35	PEL	5322 130 34605
V 1853	BZX79-C5V6	PEL	4822 130 34173
V 1854	BZX79-C6V8	PEL	4822 130 34278

7.2.4 Integrated circuits

Posnr.	Description		Ordering code
D 1701	INTEGR.CIRCUIT NEC D7503GμP		5322 209 11237
D 1702	PCF8570P	PEL	5322 209 11065
D 1703	OQ0071		5322 209 81901
A 1101	OQ0067A		5322 209 81883
A 1301	OQ0068A		5322 209 81884
A 1401	OQ0066A		5322 209 82081

7.2.5 X-tal

Posnr.	Description		Ordering code
B 1101	CSB455E	MU	5322 242 70827

7.2.6 All types and versions PM2618X/11 PM2718X/11

Posnr.	Description	Ordering code
R 2001	MR25 1% 10K	4822 116 51253
R 2002	MR25 1% 10K	4822 116 51253
R 2003	MR25 1% 6K19	5322 116 55426
R 2004	MR25 1% 2K49	5322 116 50581
R 2005	CTP10 20% 100K	4822 100 10052
R 2006	RESISTOR LDR	4822 130 31373
C 2001	-10+50% 220UF	5322 124 24189
C 2002	-20+80% 22NF	4822 122 30103
C 2003	-20+80% 22NF	4822 122 30103
V 2001	BC549C PEL	4822 130 44246
V 2002	BC549C PEL	4822 130 44246
V 2003	BC549C PEL	4822 130 44246
D 2001	HEF4093BD PEL	5322 209 14927
F 1001	F 5X20 630MA	4822 253 20015
L 2001	10MH	5322 158 10304
T 2001	OR TFE2010	5322 144 10067
X 1004		5322 268 14031
X 1006		5322 268 14031
X 2001		5322 268 14141
X 2001		5322 268 24116
X 2002	5-P DIPS 2.50	5322 265 30385

7.2.7 PM2618/31

Resistors

Posnr.	Description	Ordering code
R 2001	MR25 1% 10K	4822 116 51253
R 2002	MR25 1% 10K	4822 116 51253
R 2003	MR25 1% 6K19	5322 116 55426
R 2004	MR25 1% 2K49	5322 116 50581
R 2005	CTP10 20% 100K	4822 100 10052
R 2007	MR25 1% 1M	5322 116 55535
R 2010	MR25 1% 59K	5322 116 54678
R 2011	MR25 1% 59K	5322 116 54678
R 2012	MR25 1% 59K	5322 116 54678
R 2013	MR25 1% 100K	4822 116 51268
R 2014	MR25 1% 16K2	5322 116 55361
R 2015	MR25 1% 383K	5322 116 55335
R 2016	CTP10 20% 1M	4822 100 10089
R 2017	VR25 5% 6M8	4822 110 72209
R 2018	MR25 1% 4K64	5322 116 50484
R 2019	CTP10 20% 1M	4822 100 10089
R 2020	MR25 1% 464K	5322 116 55207
R 2021	VR25 5% 6M8	4822 110 72209
R 2022	MR25 1% 383K	5322 116 55335
R 2023	MR25 1% 4K64	5322 116 50484
R 2024	CTP10 20% 4K7	4822 100 10036
R 2025	MR25 1% 464K	5322 116 55207
R 2027	MR25 1% 121K	5322 116 54704
R 2028	MR25 1% 2K49	5322 116 50581
R 2029	CTP10 20% 1M	4822 100 10089
R 2030	CTP10 20% 1M	4822 100 10089
R 2031	VR25 5% 6M8	4822 110 72209
R 2032	VR25 5% 6M8	4822 110 72209
R 2033	MR25 1% 2K37	5322 116 54576
R 2034	VR25 5% 6M8	4822 110 72209
R 2035	MR25 1% 38K3	5322 116 55369
R 2036	MR25 1% 100K	4822 116 51268
R 2037	VR25 5% 6M8	4822 110 72209
R 2038	VR25 5% 6M8	4822 110 72209
R 2039	VR25 5% 6M8	4822 110 72209
R 2040	MR25 1% 2K37	5322 116 54576
R 2041	MR25 1% 38K3	5322 116 55369
R 2042	MR25 1% 383K	5322 116 55335

Capacitors

Posnr.	Description	Ordering code
C 2001	-10+50% 220UF	5322 124 24189
C 2002	-20+80% 22NF	4822 122 30103
C 2003	-20+80% 22NF	4822 122 30103
C 2010	2% 220PF	5322 122 34047
C 2011	63V 10% 680NF	5322 121 40233
C 2012	63V 10% 680NF	5322 121 40233
C 2013	63V 10% 680NF	5322 121 40233
C 2014	63V 10% 680NF	5322 121 40233
C 2015	-20+80% 22NF	4822 122 30103
C 2016	-20+80% 22NF	4822 122 30103
C 2017	-20+80% 22NF	4822 122 30103

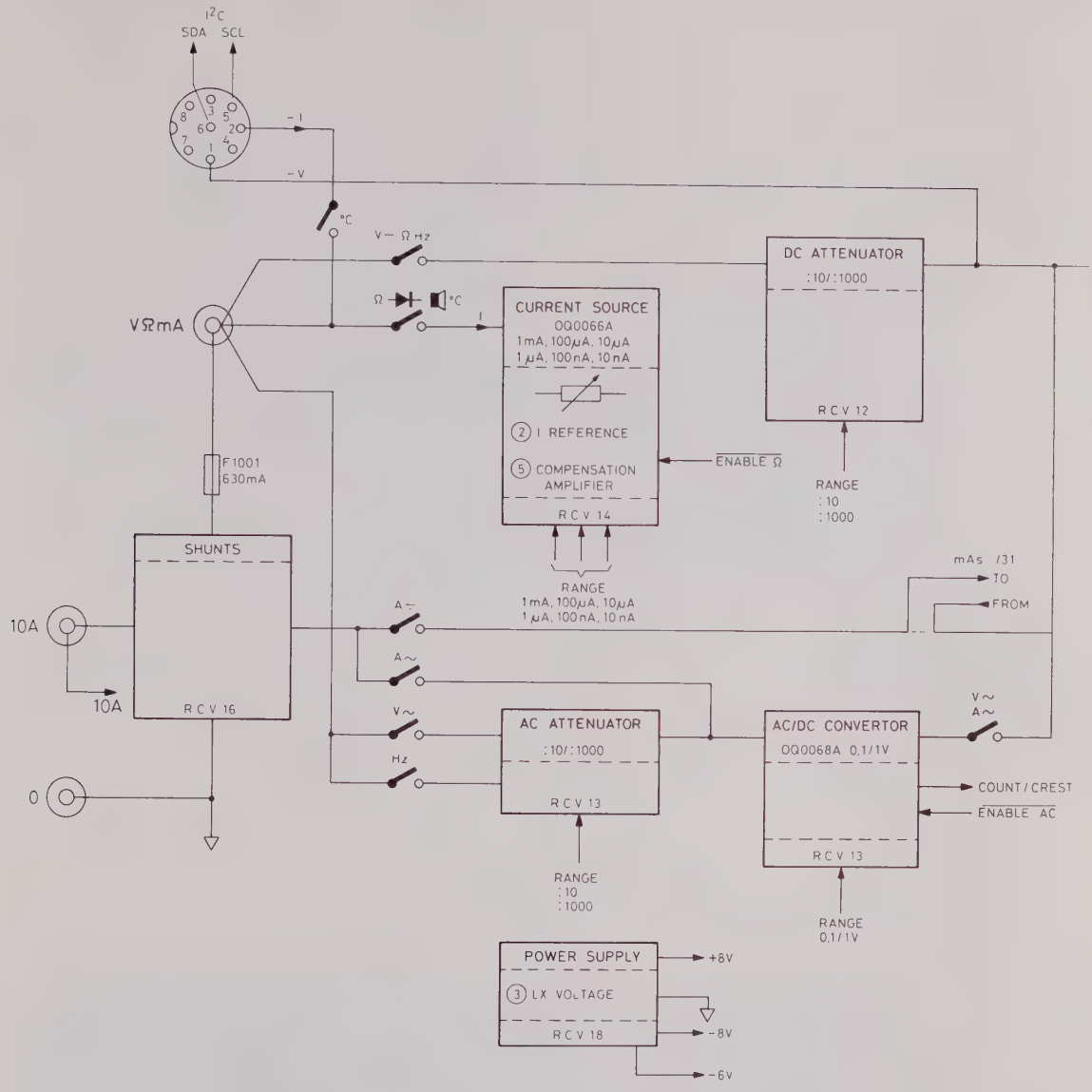
Semiconductors/Integrated circuits

Posnr.	Description		Ordering code
V 2001	BC549C	PEL	4822 130 44246
V 2002	BC549C	PEL	4822 130 44246
V 2003	BC549C	PEL	4822 130 44246
V 2010	BC559B	PEL	4822 130 44358
V 2011	BC549C	PEL	4822 130 44246
V 2012	BC549C	PEL	4822 130 44246
V 2013	BC549C	PEL	4822 130 44246
V 2014	BF256A	PEL	5322 130 44418
V 2015	BFW13	PEL	5322 130 40516
V 2016	BAW62	PEL	4822 130 30613
V 2017	BAW62	PEL	4822 130 30613
V 2018	BAW62	PEL	4822 130 30613
V 2019	BC549C	PEL	4822 130 44246
V 2020	BC549C	PEL	4822 130 44246
D 2001	HEF4093BD	PEL	5322 209 14927

Miscellaneous

Posnr.	Description	Ordering code
R 2006	RESISTOR LDR	4822 130 31373
L 2001	2200UH	5322 158 10329
T 2001	OR TFE2010	5322 144 10067
X 1004		5322 268 14031
X 1006		5322 268 14031
X 1007		5322 268 14031
X 1008	8-P PW HAAKS	5322 267 54107
X 1010		5322 492 63049
X 1015	HEC0739-01-010	4822 267 30431
X 1017	2-P SNG 12.45	5322 265 20266

8. CIRCUIT DIAGRAMS AND PRINT LAY-OUTS



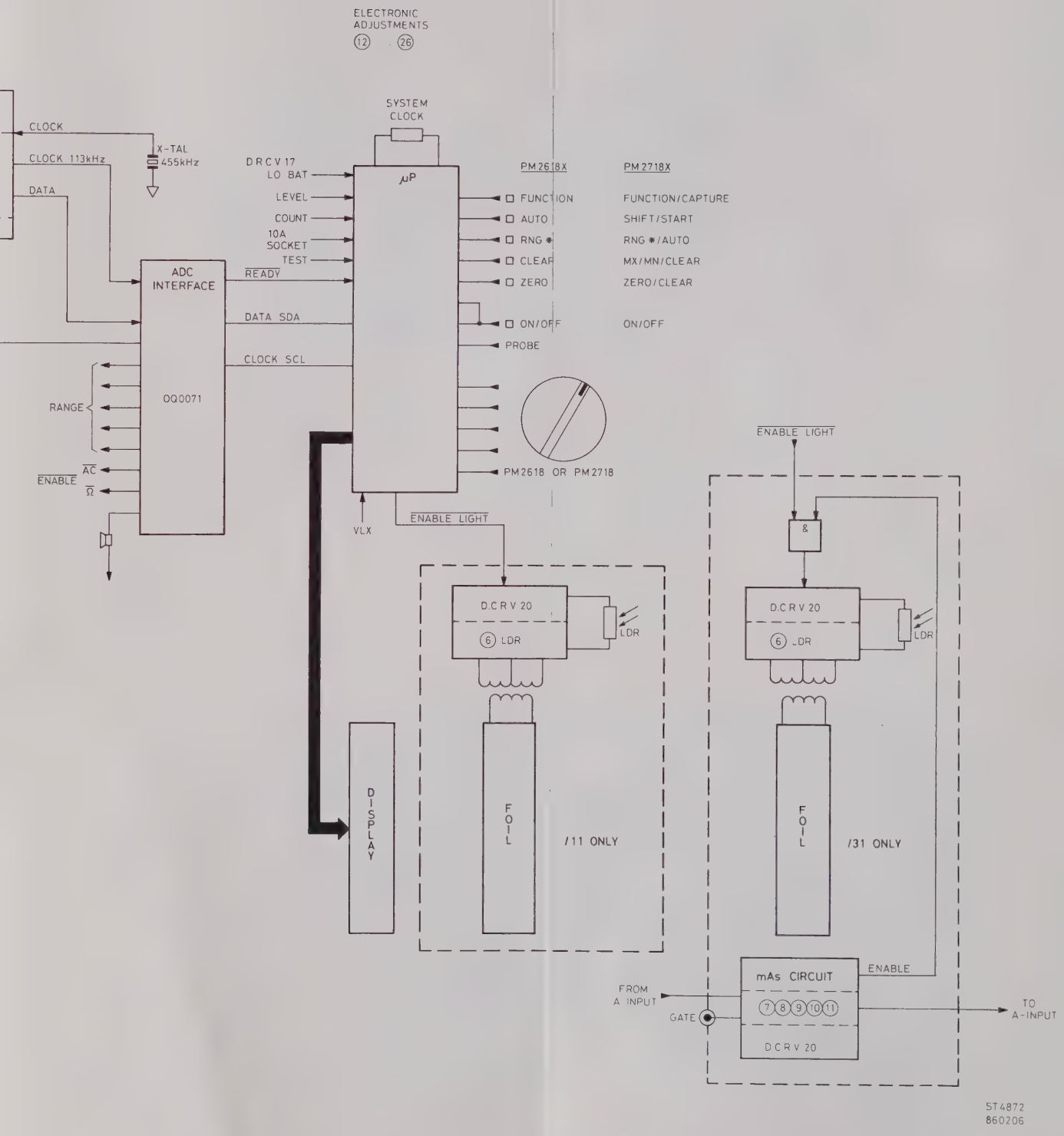
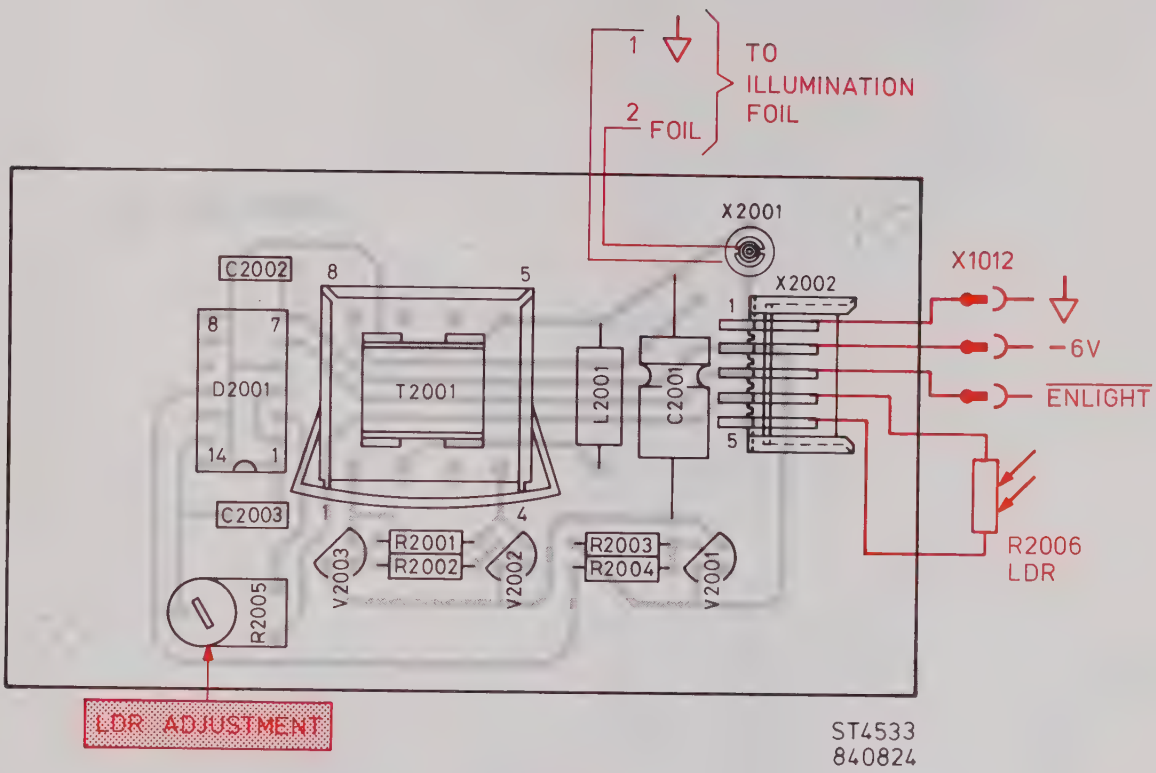


Figure 8.1 Block diagram PM2618X/01/11/31
PM2718X/01/11



Illumination pcb N2 component side PM2618X/11 - PM2718X/11

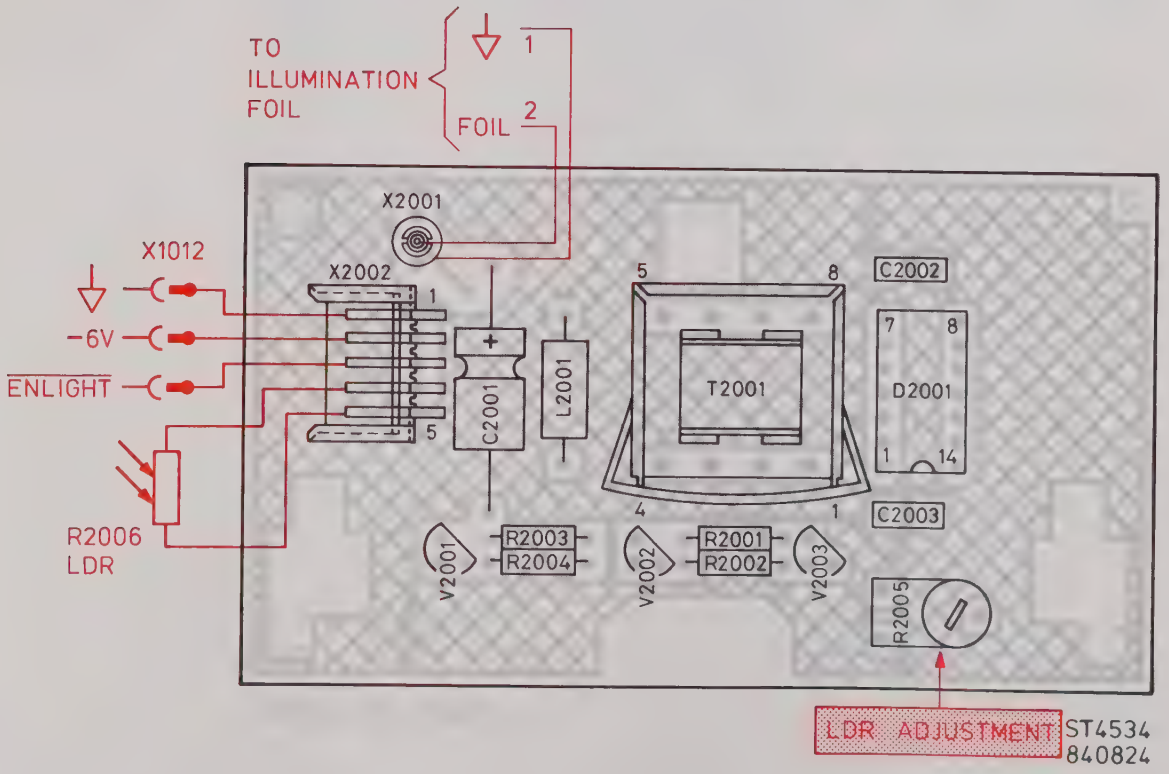
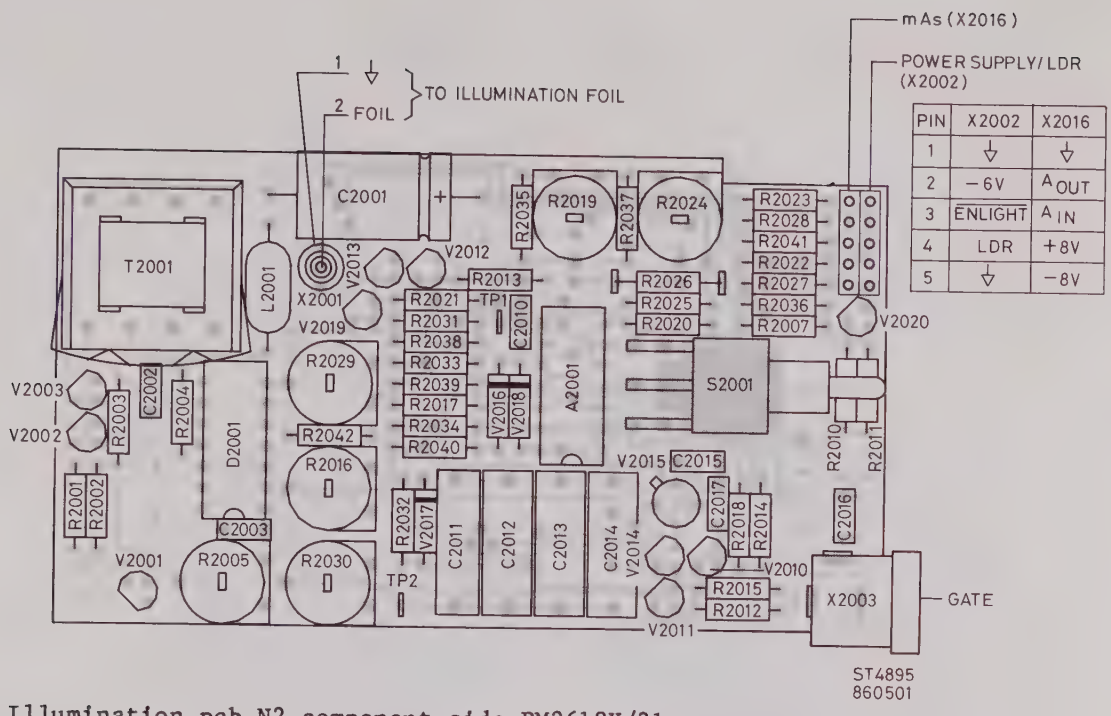


Figure 8.2 Illumination pcb N2 conductor side PM2618X/11 - PM2718X/11



Illumination pcb N2 component side PM2618X/31

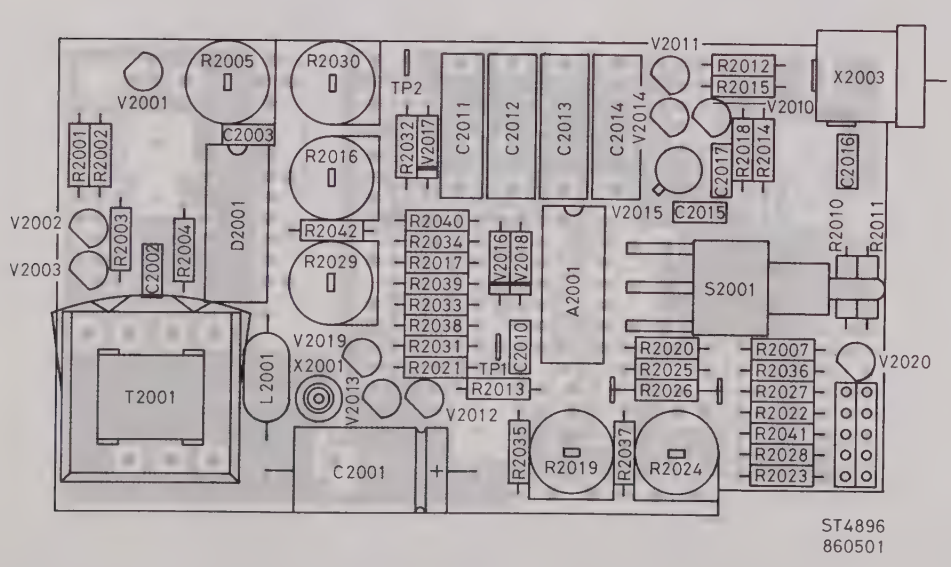


Figure 8.3 Illumination pcb N2 conductor side PM2618X/31

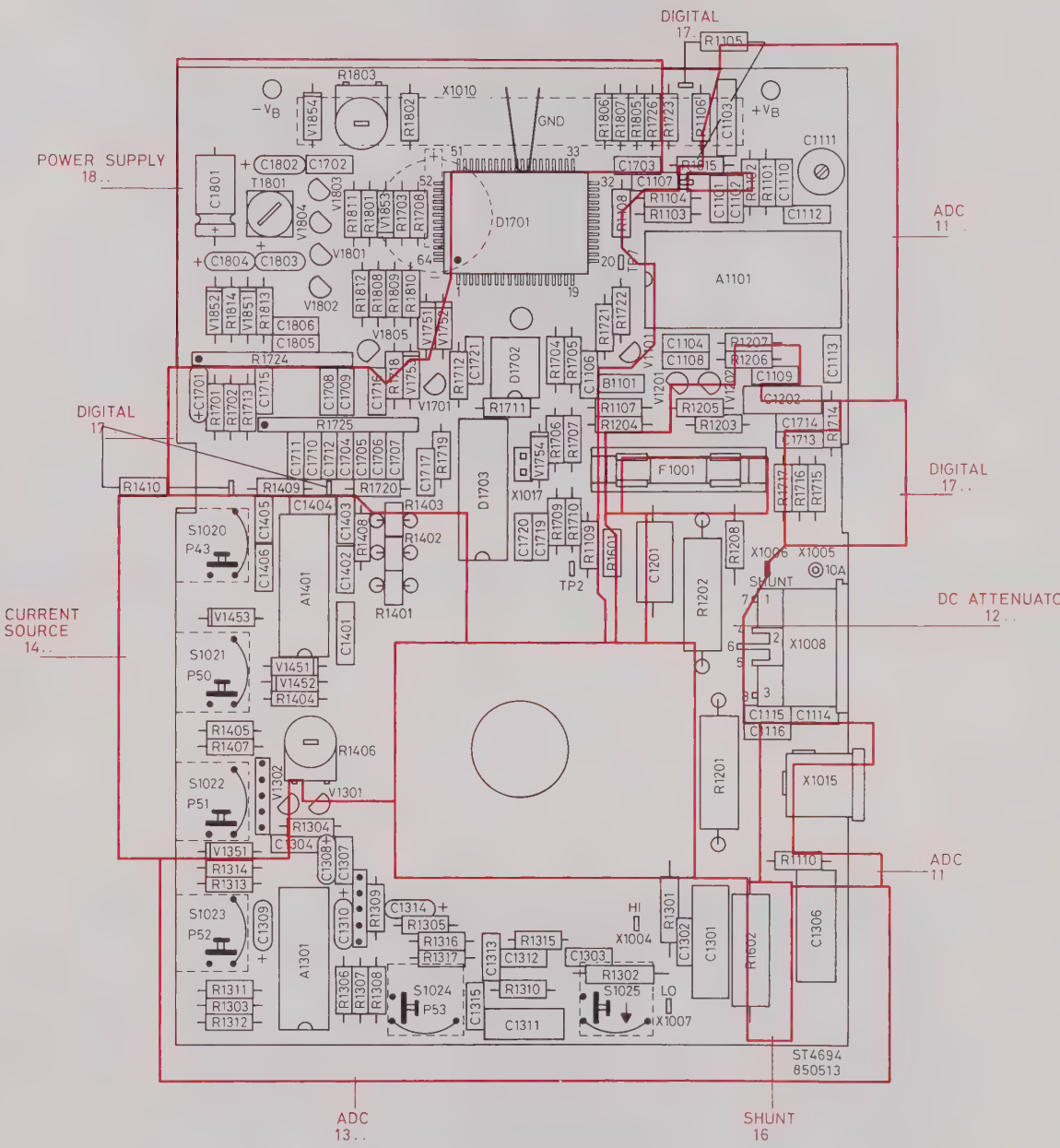


Figure 8.4 Parts location PM2618X/01/11/31 - PM2718X/01/11

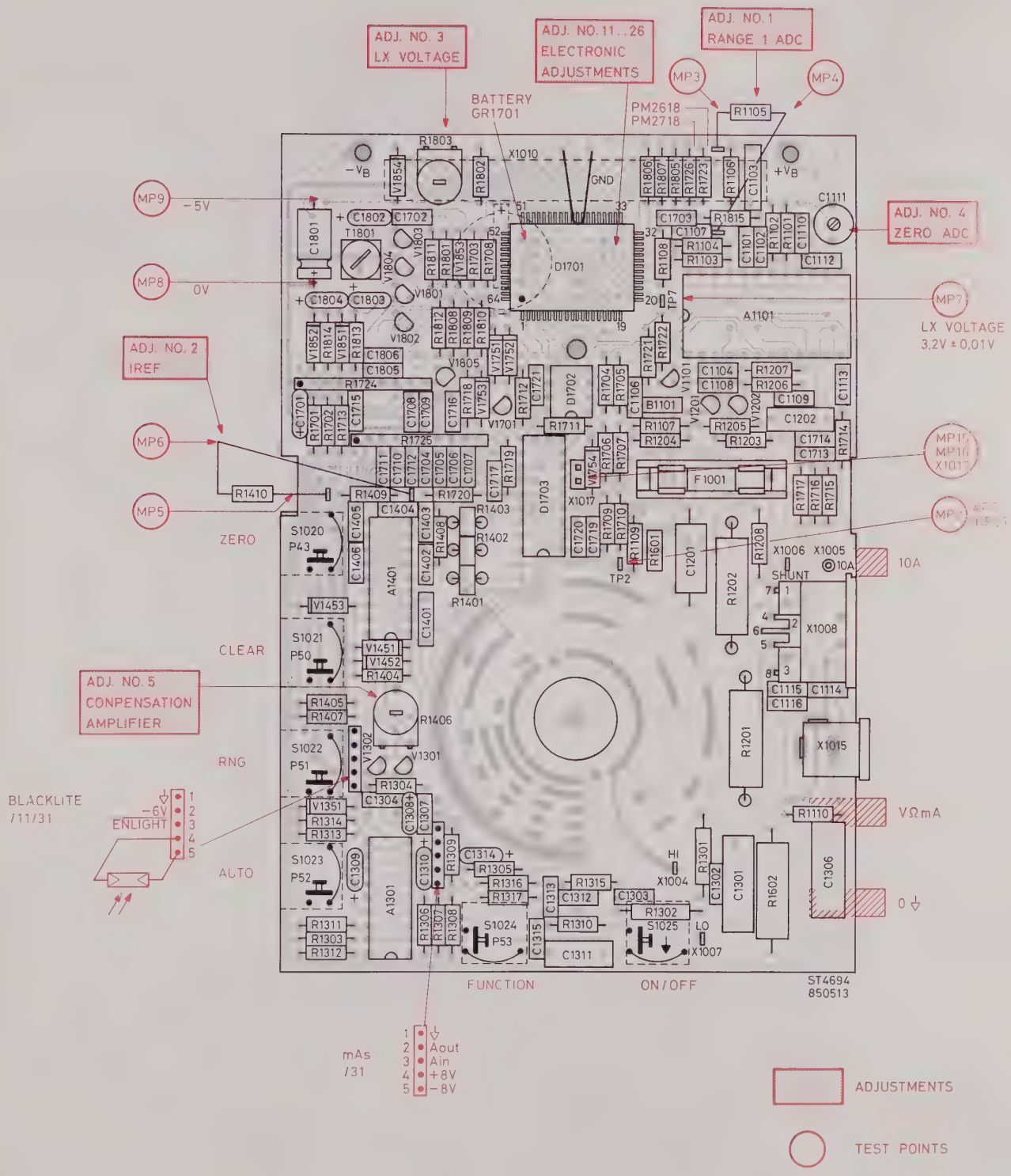


Figure 8.5 Printed circuit board PM2618X/01/11/31 - PM2718X/01/11
component side

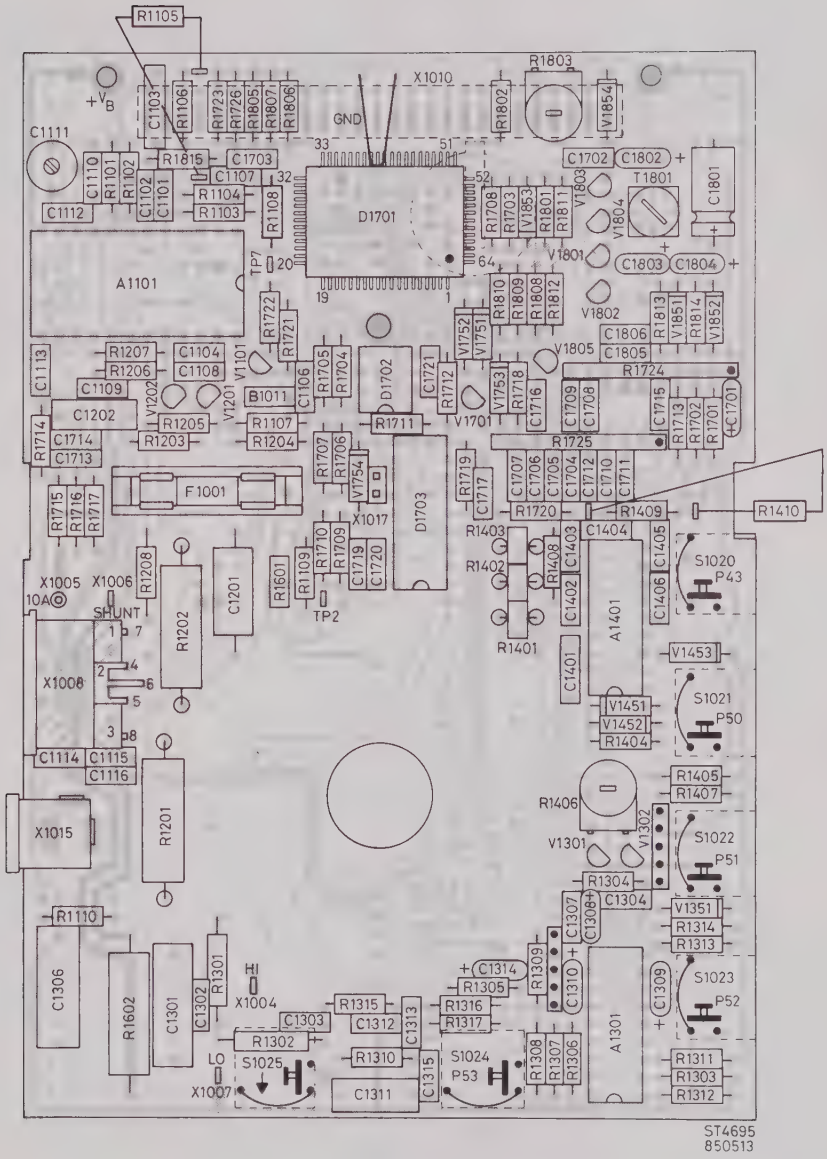
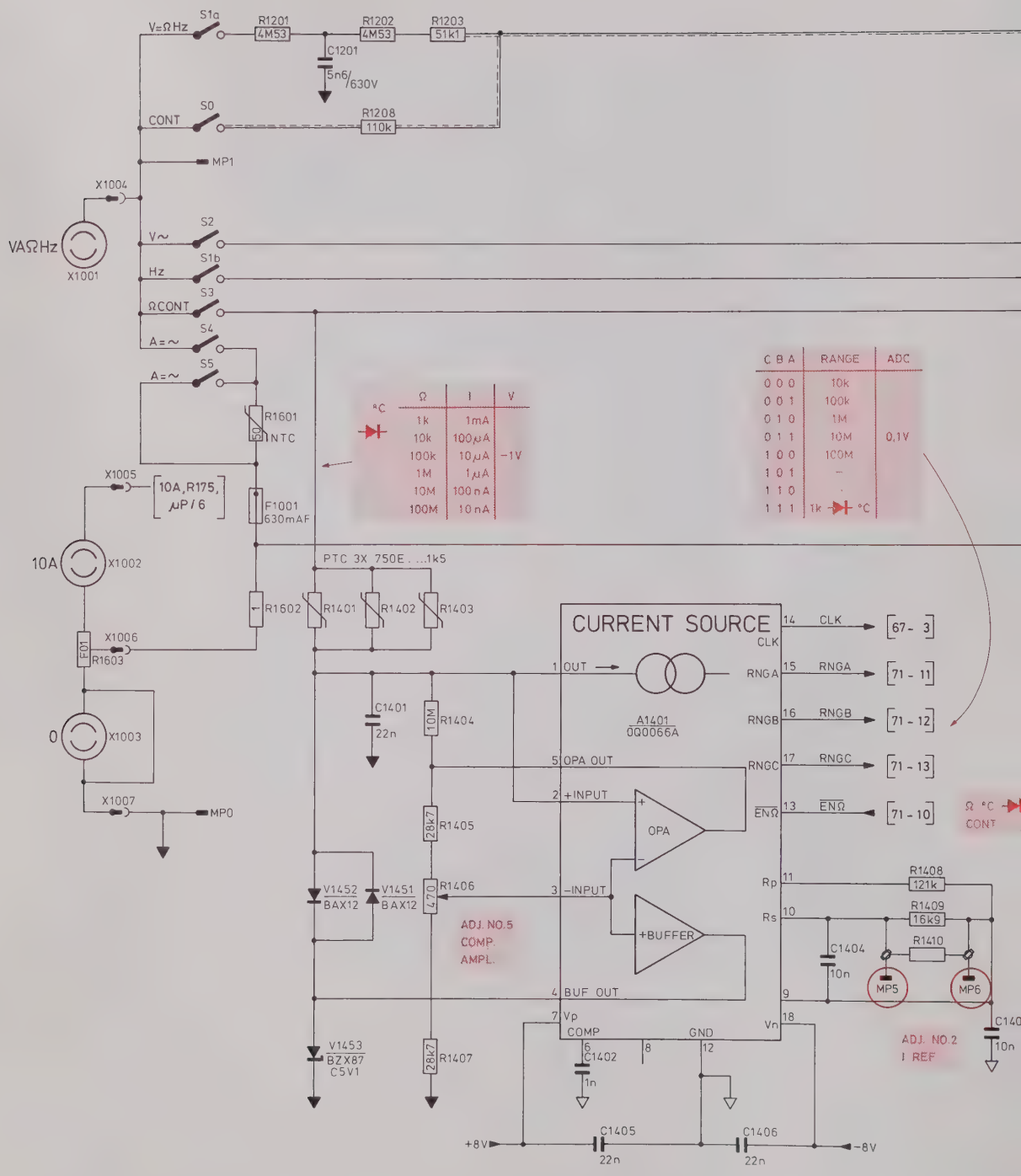
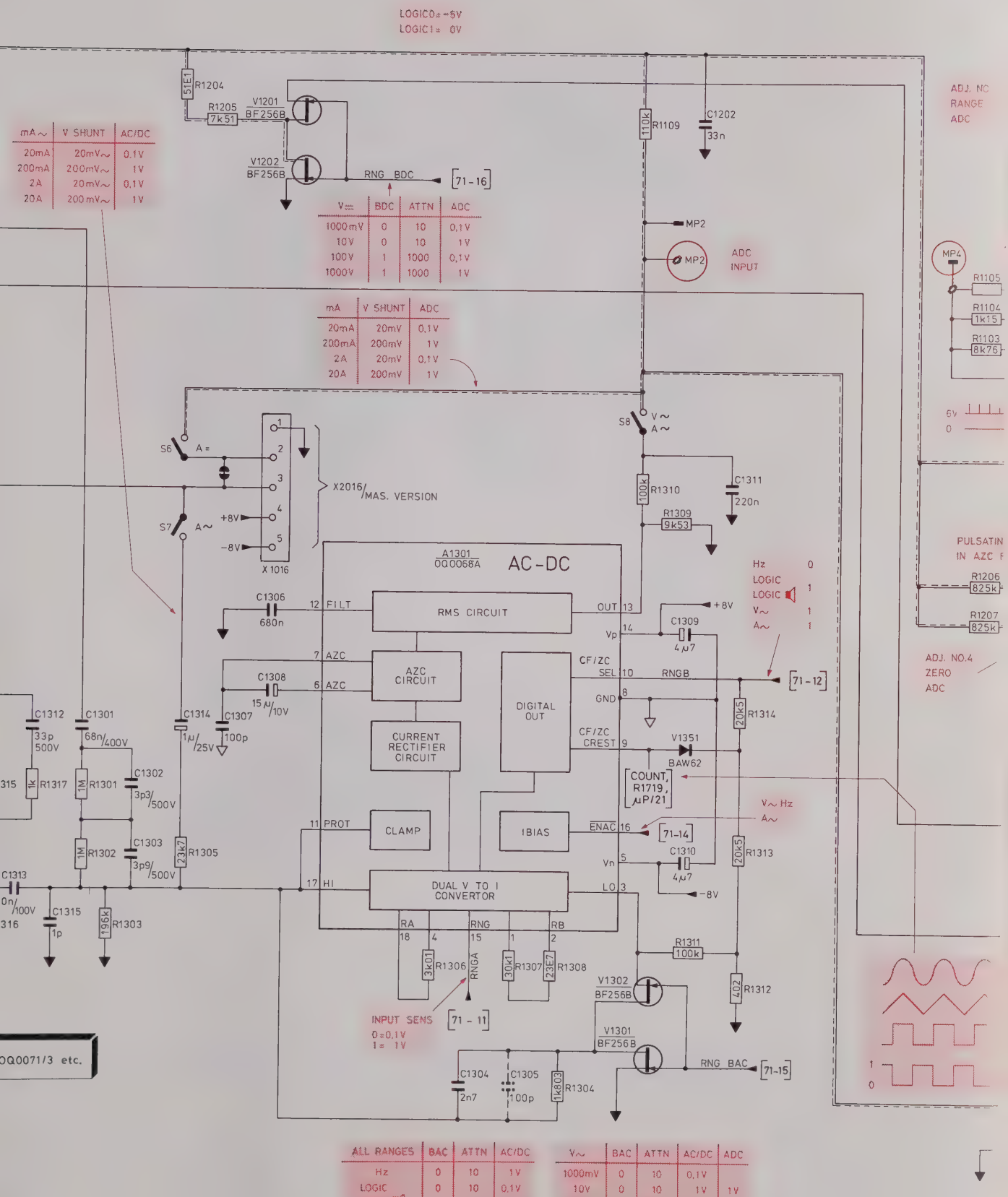


Figure 8.6 Printed circuit board PM2618X/01/11/31 - PM2718X/01/11 conductor side


V=ΩHz
S1a
R1201 4M53
R1202 4M53
R1203 51k1
C1201 5n6/630V
CONT
S0
R1208 110k
MP1
X1004
VAΩHz
X1001
V~
S2
Hz
S1b
ΩCONT
S3
A=~
S4
A=~
S5
R1601 NTC
X1005
10A,R175, µP/6
F1001 630mAF
10A
X1002
PTC 3X 750E. ...1k5
R1602
R1401
R1402
R1403
F01
X1006
R1603
0
X1003
X1007
MP0
C1401 22n
10M
R1404
28k7
R1405
V1452 BAX12
V1451 BAX12
470
R1406
ADJ. NO.5 COMP. AMPL.
V1453 BZX87 C5V1
28k7
R1407
CURRENT SOURCE
CLK
1 OUT
A1401 0Q0066A
5 OPA OUT
2 +INPUT
3 -INPUT
4 BUF OUT
OPA
+BUFFER
7 Vp
COMP
GND
6
8
12
C1402 1n
+8V
C1405 22n
C1406 22n
-8V
14 CLK
15 RNGA
16 RNGB
17 RNGC
13 ENΩ
[67 - 3]
[71 - 11]
[71 - 12]
[71 - 13]
[71 - 10]
Ω °C CONT
Rp 11
Rs 10
Vn 18
9
R1408 121k
R1409 16k9
R1410
C1404 10n
MP5
MP6
ADJ. NO.2 I REF
C140 10n
°C
Ω I V
1k 1mA
10k 100µA
100k 10µA -1V
1M 1µA
10M 100nA
100M 10nA
C B A RANGE ADC
0 0 0 10k
0 0 1 100k
0 1 0 1M
0 1 1 10M 0,1V
1 0 0 100M
1 0 1 –
1 1 0 –
1 1 1 1k °C



mA ~	V SHUNT	AC/DC
20mA	20mV~	0.1V
200mA	200mV~	1V
2A	20mV~	0.1V
20A	200mV~	1V

V ⎓	BDC	ATTN	ADC
1000mV	0	10	0.1V
10V	0	10	1V
100V	1	1000	0.1V
1000V	1	1000	1V

mA	V SHUNT	ADC
20mA	20mV	0.1V
200mA	200mV	1V
2A	20mV	0.1V
20A	200mV	1V

ALL RANGES	BAC	ATTN	AC/DC
Hz	0	10	1V
LOGIC	0	10	0.1V
LOGIC	0	10	0.1V

V~	BAC	ATTN	AC/DC	ADC
1000mV	0	10	0.1V	1V
10V	0	10	1V	
100V	1	1000	0.1V	
1000V	1	1000	1V	

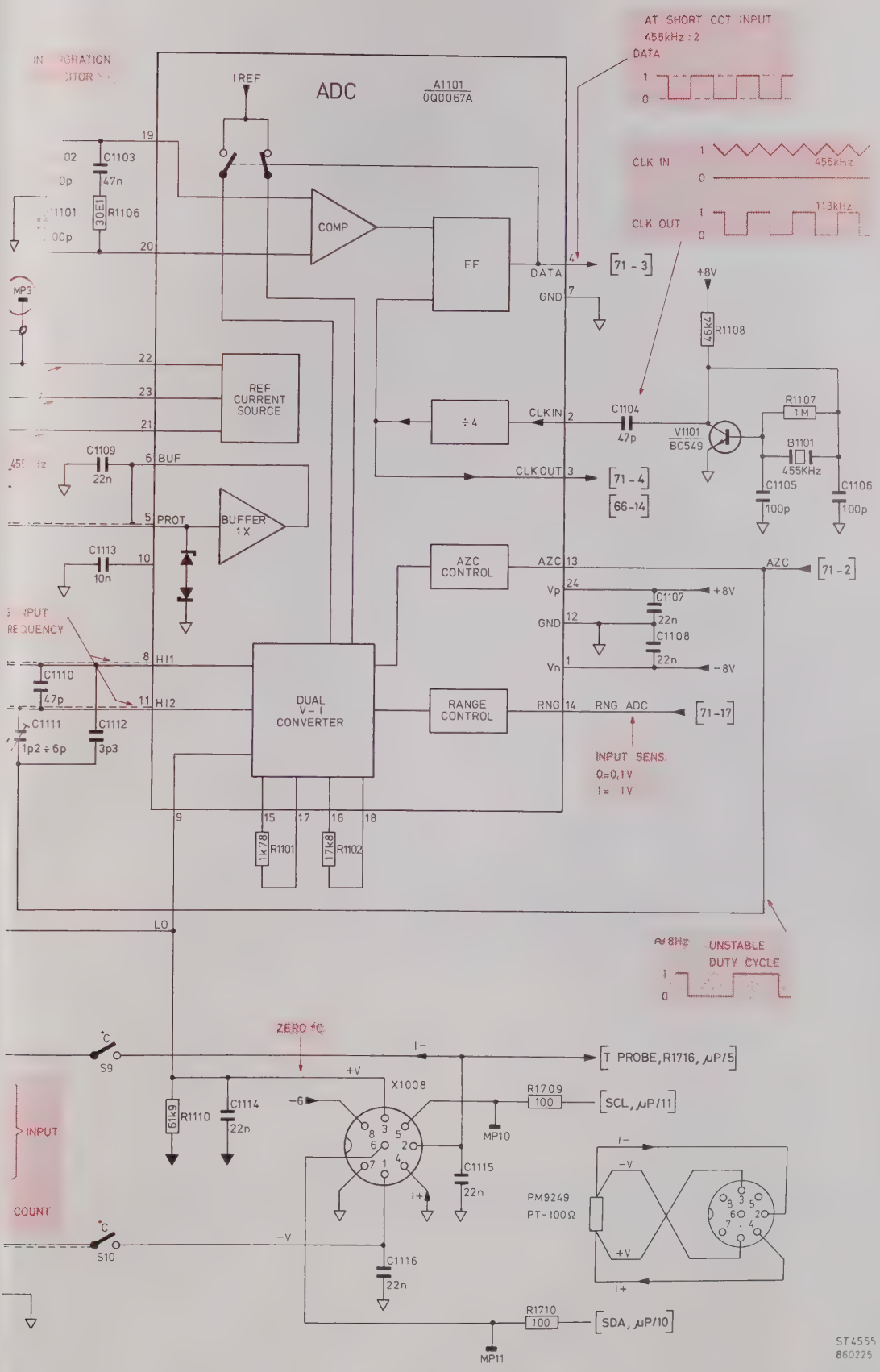


Figure 8.7 Circuit diagram analog

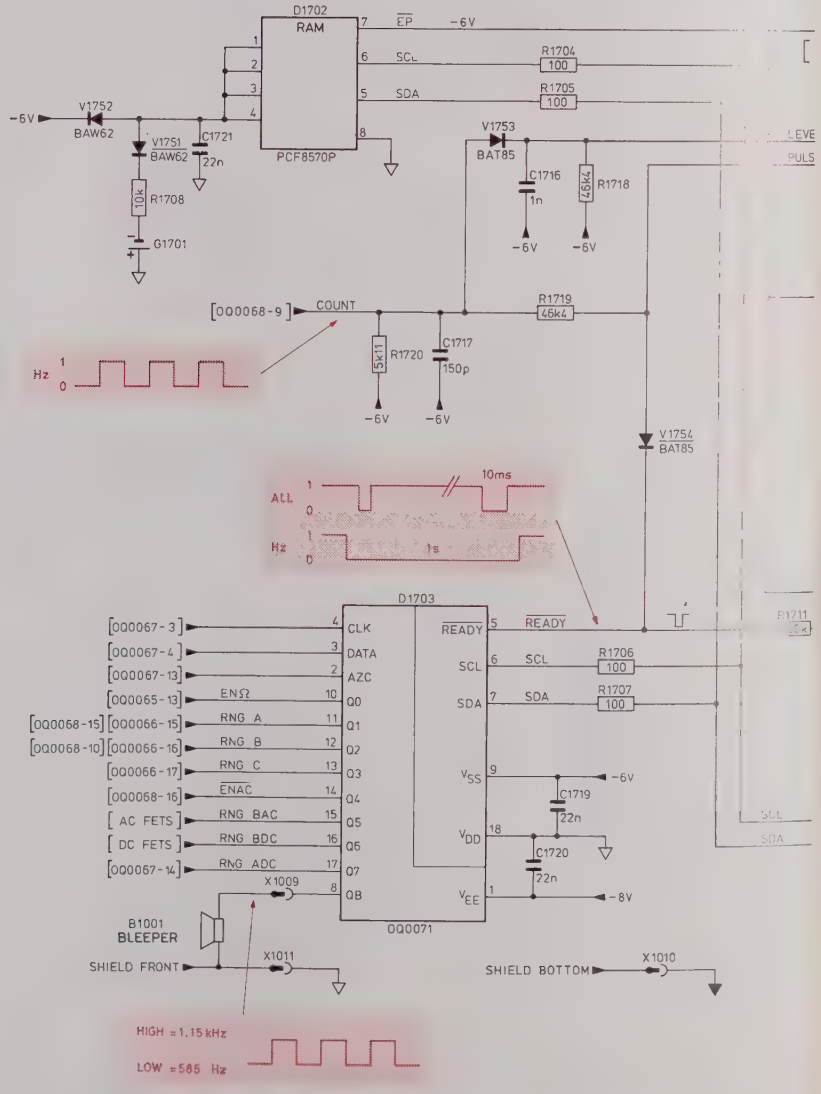
SWITCHING TABLE

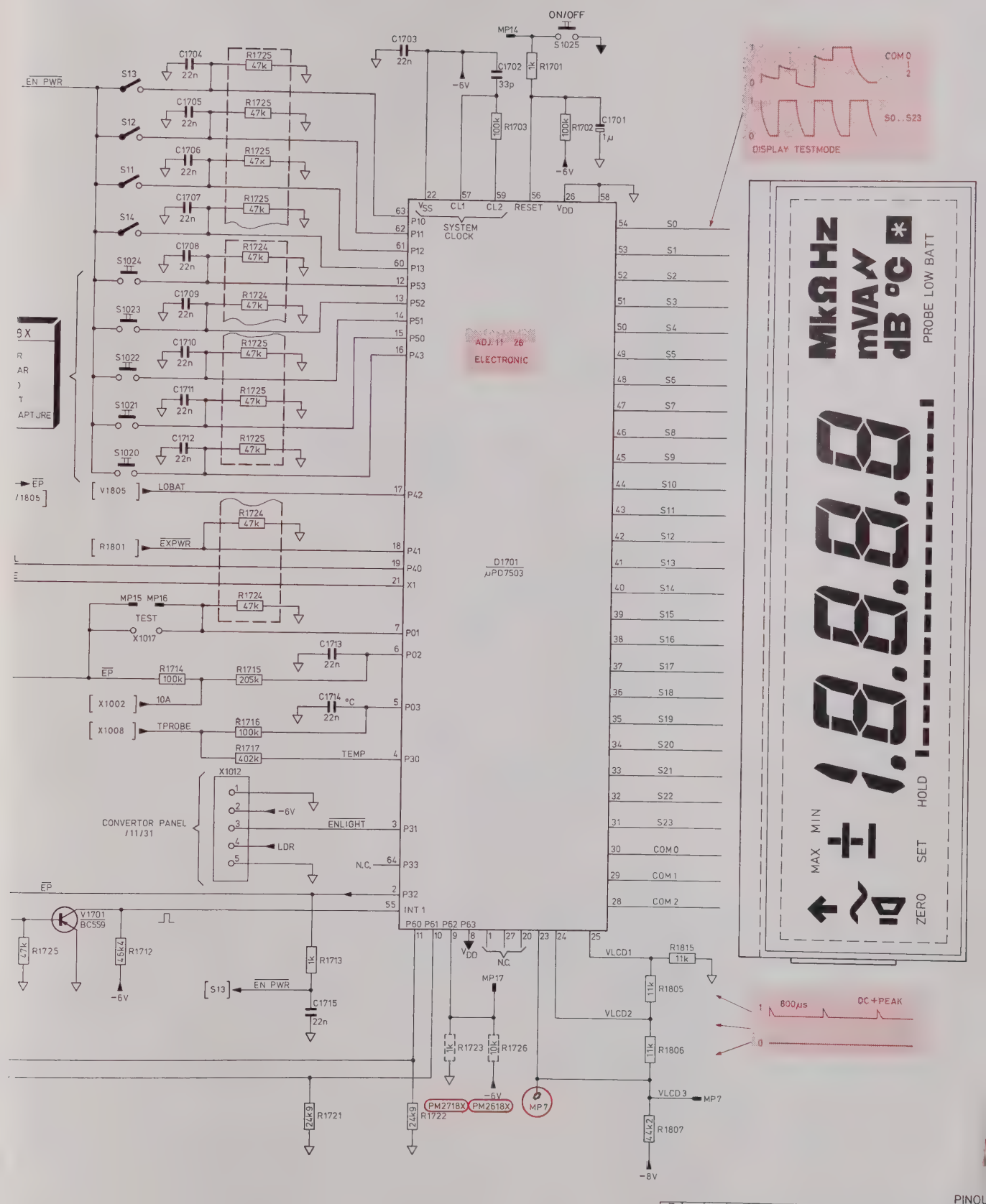
S	Hz	V~	V ⎓	Ω	⇥/🔊	°C	A ⎓	A~
0					•			
1a	•		•	•				
1b	•							
2		•						
3				•	•			
4						•	•	•
5							•	•
6							•	
7								•
8		•						
9						•		
10						•		
11				•	•	•		
12				•			•	•
13			•		•		•	
14	•							

• CONTACT CLOSED

LOGIC 0 = -5V
LOGIC 1 = 0

	PM2
S1020	ZERO
S1021	CLEAR
S1022	RNG *
S1023	AUTO
S1024	FUNCT ON

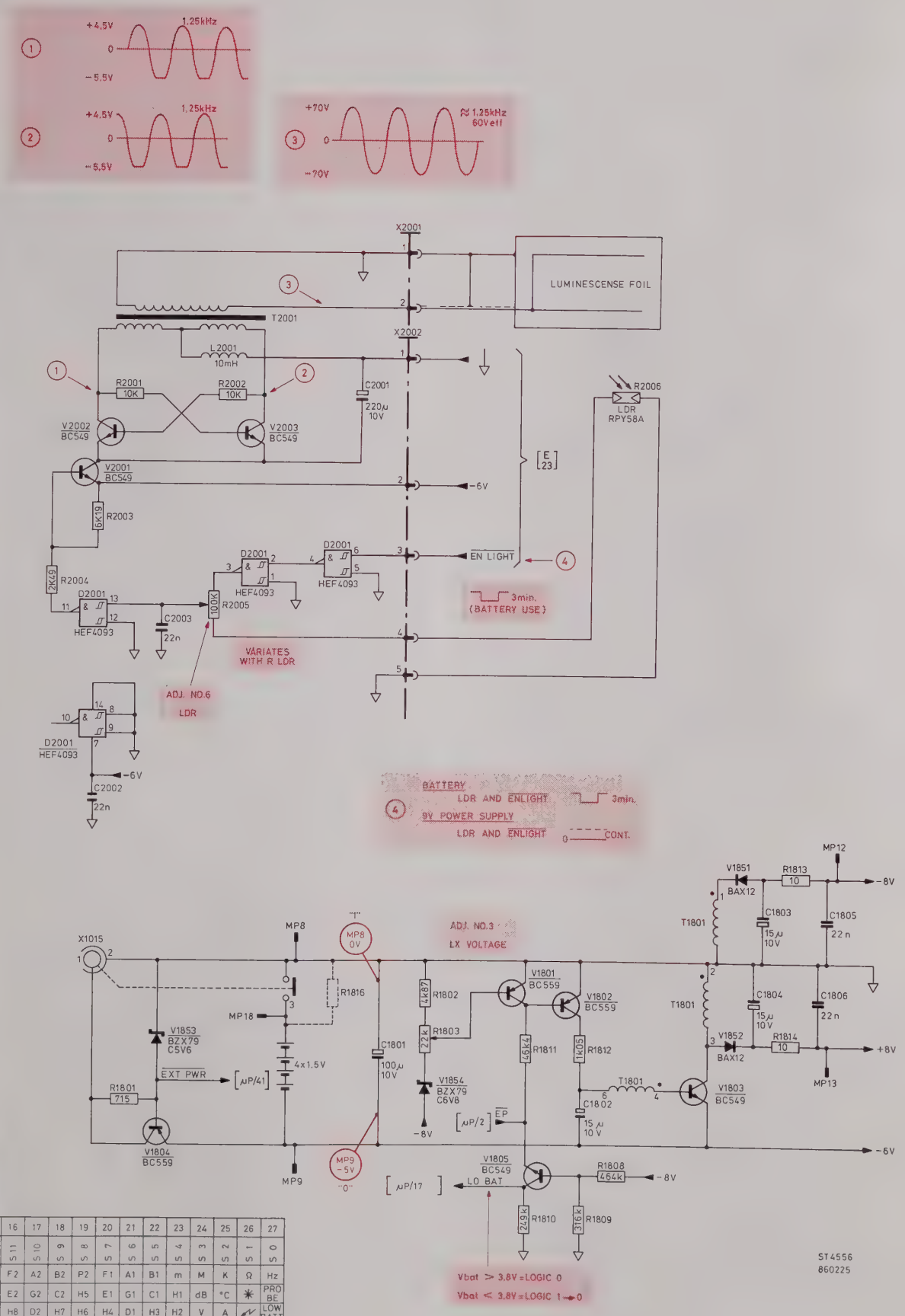




PINOU

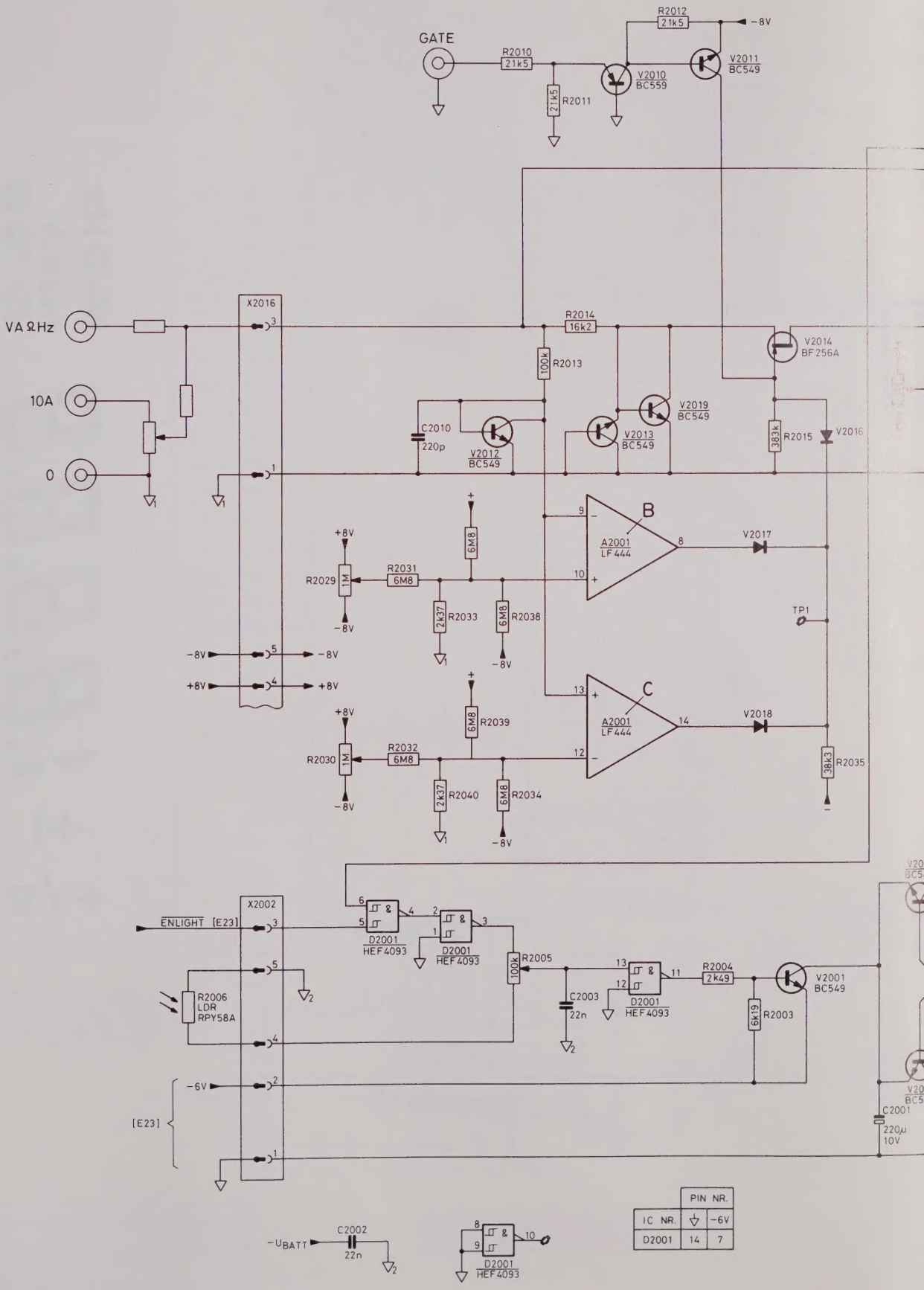
COM	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SYM	COM 2	COM 1	COM 0	S 23	S 22	S 21	S 20	S 19	S 18	S 17	S 16	S 15	S 14	S 13
SEGMENT				▲	MAX	MIN		F4	A4	B4	P4	F3	A3	B3
				~	+	−	HOLD	E4	G4	C4	H13	E3	G3	C3
				🔊	ZERO	SET	H17	H16	D4	H15	H14	H12	D3	H11

VERSION/11



UT	15	16	17	18	19	20	21	22	23	24	25	26	27
	S12	S11	S10	S9	S8	S7	S6	S5	S4	S3	S2	S1	S0
B	P3	F2	A2	B2	P2	F1	A1	B1	m	M	K	Ω	Hz
B	H9	E2	G2	C2	H5	E1	G1	C1	H1	dB	°C	✳	PRO BE
1	H10	H8	D2	H7	H6	H4	D1	H3	H2	V	A	✓	LOW BATT

Figure 8.8 Circuit diagram digital


GATE
R2010 21k5
R2011 21k5
R2012 21k5
-8V
V2010 BC559
V2011 BC549
VA ΩHz
10A
0
X2016
R2014 16k2
R2013 100k
V2014 BF256A
C2010 220p
V2012 BC549
V2013 BC549
V2019 BC549
383k R2015
V2016
B
A2001 LF444
V2017
R2029 1M
R2031 6M8
6M8
2k37 R2033
6M8 R2038
TP1
-8V
+8V
C
A2001 LF444
V2018
R2030 1M
R2032 6M8
R2039 6M8
2k37 R2040
6M8 R2034
38k3 R2035
X2002
ENLIGHT [E23]
D2001 HEF4093
R2005 100k
C2003 22n
R2004 2k49
V2001 BC549
6k19 R2003
R2006 LDR RPY58A
-6V
[E23]
C2001 220µ 10V
-UBATT
C2002 22n
PIN NR.
IC NR. | ⏚ | -6V
D2001 | 14 | 7

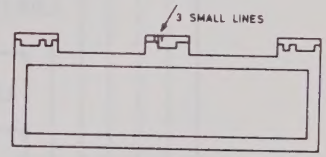
① 5322 694 54027 LX assembly for PM2518X/01
Consists of: - LX display for PM2518X/01 reflective
- Rubber 5 mm
- Window thin

② 5322 694 54028 LX assembly for PM2518X/11
Consists of: - LX display PM2518X/11 transflective, window thin, LDR holder, LDR, Back light and wiring
- Rubber 5 mm

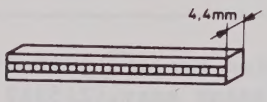
③ 5322 694 54029 LX assembly for PM2618X/01, PM2718X/01
Consists of: - LX display PM2618X/01, PM2718X/01 (reflective)
- Rubber 5 mm
- Window thin

④ 5322 694 54031 LX assembly for PM2618X/11/31, PM2718X/11
Consists of: - LX display PM2618X/11/31, PM2718X/11 (transflective)
- Window thin
- Backlight
- Rubber 5 mm
- Wiring for /11 (for /31 the wiring has to be modified in the instrument itself)

Markings: Window thick (old) : no marking
Window thin (new) :



Rubber 4,4 mm (old) :



Rubber 5 mm (new) :

b. Zero adjustment current function

Problem: Negative offset on the display of -1 or -2 digits in the (m)A DC function

Remedy: Mount a resistor of approximately 562k Ohm between pin 2 and pin 4 of connector X1016. Normally this connector is not used. In the PM2618/31 version the connector used to connect the mAs printed circuit board. Then the resistor should be mounted between pin 3 and pin 4 on the conductorside.

MP MASTER
MA28801